PECIAL COLOR TV ISSUE!

HUGO GERNSBACK, Editor-in-chief ■ JAN. 50c

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1965
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LOR TV SETS

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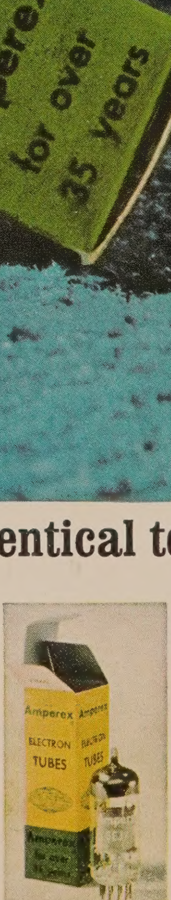

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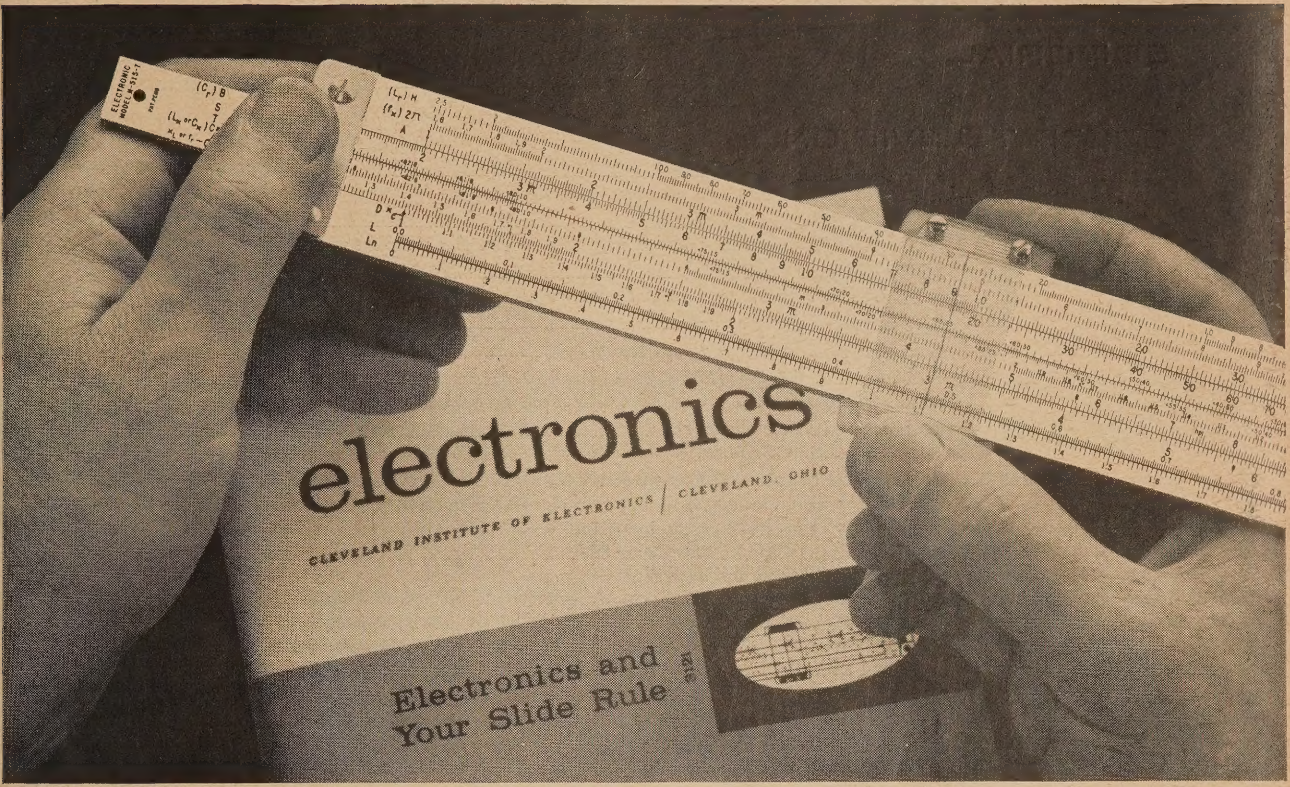
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JANUARY 1965 VOL. XXXV No. 1

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EDITORIAL

31 Color TV—Today and Tomorrow .... *Dr. Elmer W. Engstrom*

COLOR TELEVISION

32 What's New in Color Tubes? .... *David Lachenbruch*
Trends to smaller, simpler, less costly designs

34 Thinking of Color TV? .... *Matthew Mandl*
News for prospective customers, and for technicians who'll talk to customers

36 ABC's of Color TV Service .... *Robert G. Middleton*
Could be it's the long words that scare people away?

39 Glossary of Color Terms .... *Ed Bukstein*

40 Color Television Throughout the World .... *Eugene Aisberg*
Progress and problems outside the Americas

42 Schematic of the RCA CTC16 Color Television Chassis

44 Roundup of 1965 Color Sets .... *Robert F. Scott*
The lowdown on features and circuits in this year's Color TV receivers

47 Color Test Equipment: Lectrotech V-7, B&K 1240, Mercury 900, Seco 980–990
Color Generator and Vectorscope, Color-Bar Generator,
Color TV Analyzer, Signal Generators

50 No-Instrument Checks for Color TV .... *Jack Darr*
For technician and owner

55 On the Cover—Color Pattern Generator

AUDIO-HIGH FIDELITY-STEREO

54 The Pushbutton Projectionist .... *Nelson S. Brooks, W2DQG/DL4VQ*
Mate stereo recorder with auto-trip slide projector, show slides the elegant way

76 Equipment Report: Shure M100L
Portative Phono System

ELECTRONICS

52 Solar Cell Circuits .... *Donald L. Stoner*
Simple experimental hookups for everyone

GENERAL

53 What's Your EQ?

61 Service Clinic .... *Jack Darr*
The Color TV Signal

RADIO

56 More Range from CB Rigs .... *Robert F. Scott*
Sideband-reduction is almost like getting something for nothing

72 At Last—Wireless Power Transmission .... *Peter E. Sutheim*
Radio-powered craft opens new vistas in unmanned flight

TEST INSTRUMENTS

47 Color Test Equipment Reports: Lectrotech V-7, B&K 1240, Mercury 900
Seco 980–990
Color Generator and Vectorscope, Color-Bar Generator,
Color TV Analyzer, Signal Generators

THE DEPARTMENTS

22 Correspondence
113 New Books
90 New Literature
109 New Patents
84 New Products
77 New Semiconductors & Tubes
6 News Briefs
104 Noteworthy Circuits
101 Technicians' News
93 Technotes
105 Try This One
53 50 Years Ago

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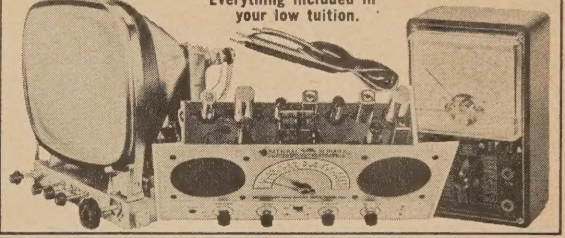

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NEWS BRIEFS

STARS ARE TALKING TO US?

High-intensity radio signals in the 900-mc range, coming from invisible pinpoints in the sky, may be superbeacons of a supercivilization trying to get in touch with us or other worlds.

This was suggested by the Soviet astronomer Nikolai Kardashev, of the Sternberg State Astronomical Institute, where he works under leading Soviet astronomer Professor Shklovsky. His statement was read at a scientific conference on "extraterrestrial civilizations," sponsored by the Armenian Academy of Sciences.

The 900-mc frequency, according to Kardashev, is one that could be chosen by intelligent beings for interstellar communications. Two types of noise hamper transmission over the vast distances of space. One of these is cosmic noise, from space itself. The other is noise produced in the receiving equipment. Both are frequency-sensitive, and their combined effects reach a minimum in the 900-mc range.

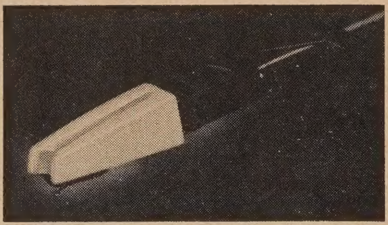
Kardashev also pointed out that the spectra of these radio emissions are unlike any of the other sources of cosmic radio waves.

Kardashev follows Professor Shklovsky's idea that a highly advanced civilization might try to draw attention to itself with an extraordinarily powerful radio beacon. By projecting our advances in power production ahead only 3,200 years, he postulates a "Type Two" civilization that might be able to produce enough power for such interstellar signaling.

SEMICONDUCTOR PHONO PICKUP HAS DC-TO-30-KC RESPONSE

A new stereo phonograph pickup uses semiconducting silicon elements smaller than its diamond stylus tip and has a source impedance of only 600 ohms. It was introduced by Euphonics Corp. of Guaynabo, Puerto Rico.

The outstanding advantage of the new pickup is its low source impedance, which makes it possible to couple direct into a common-emitter transistor input stage without a high-input-impedance emitter follower, as with ceramic cartridges, or a two-stage equalized preamp, as with magnetics. Used in low-impedance circuitry, the pickup has an output of approximately 25 mv.

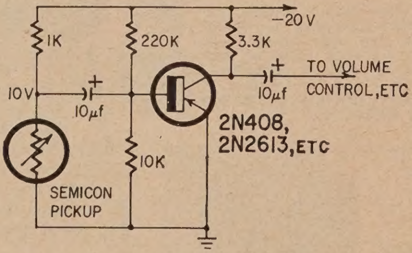


Euphonics Corp.'s new U-15 semiconductor phono pickup.

The new pickup is basically a resistive modulating device (like a carbon microphone) rather than a generating device. (Therefore it requires a power supply.) As such, it responds to steady-state signals, and thus its low-frequency response goes right down to dc. However, with the present method of coupling, a capacitor isolates the pickup's bias network from the input transistor's bias network (see the diagram). Otherwise, the steady-state bias of the input transistor would change the instant the pickup stylus touched the record and was displaced slightly. High-frequency response is claimed to extend beyond 30,000 cycles.

Initially, the pickup will be directed at original-equipment manufacturers, especially makers of high-quality packaged systems. It will be available to audiophiles within a few months, with an accessory power supply for bias current.

Separation is quoted as better than 25 db. Compliance is given as 20 × 10^{-6} cm/dyne; tracking force, 0.75 to 3 grams. The cartridge weighs 2 grams and has a replaceable elliptical stylus. Output can be pre-equalized to the RIAA characteristic, or flat to follow the response of magnetic pickups.



Suggested input circuit for new semiconductor phono pickup (one channel). With method of mechanical coupling used, channels are out of phase at pickup output; thus, 1,000-ohm load resistor and pickup would be interchanged for the second channel. Input stage transistor and parts values are conventional.

Alpha Wiggins, board chairman of Euphonics, said there was a good possibility that higher-output versions of the semiconductor pickup could be used to drive high-gain power transistors directly, making possible low-cost stereo phonographs with only a single transistor in each channel.

The audiophile version of the cartridge is expected to sell for about $25 alone, and a complete system including the cartridge, a power supply delivering about 10 ma at 20 v and a specially designed low-mass tone arm, for about $80 to $100.

NEW STAMP HONORS RADIO AMATEURS

On sale since Dec. 15, 1964, is a printing of 120 million 5-cent commemorative stamps honoring amateur radio and the 50th birthday of the American Radio Relay League. The design, purple on white, shows a modulated radio wave with a portion of a radio dial.

First-day ceremonies were held in Anchorage, Alaska. Alaskan hams figured prominently in emergency communications after the recent earthquake there.

GALLIUM PHOSPHIDE DIODES MODULATE LIGHT WAVES

The gallium phosphide diode, which emits light when forward bias is applied to it, can become a modulator of light if reverse-biased. This was reported by Drs. D. F. Nelson and F. K. Reinhart of the Bell Telephone Laboratories. The discovery was made possible by recent Bell Laboratories ad-

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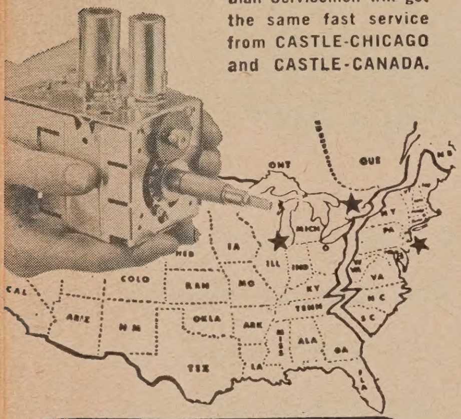

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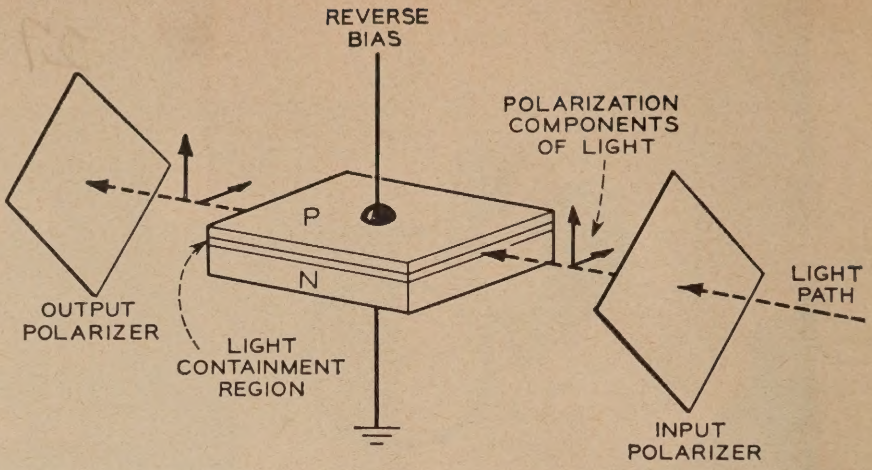

Diagram shows gallium phosphide diode method of modulation. The incoming light wave is polarized and focused on on the diode p-n junction region. The two polarization components of the light wave travel at different velocities along the planes of the p-n junction, and emerge out of phase with each other. The phase difference is approximately proportional to the reverse bias. An output polarizer changes the phase modulation to amplitude modulation.

vances in controlling the chemistry of gallium phosphide. The diodes transmit light from the green portion of the spectrum to the near infrared.

Polarized light is beamed at a gallium phosphide diode, to which reverse bias up to 31 volts is applied. The light must be coupled into the narrow p-n junction region, only 5–10 microns thick. For this reason, the laser's finely focused beam is a better source of light. The path through the diode is .025 in. long. Polarized light is applied to the junction, and the phase of the light is varied by the amount of bias. With biases up to 31 volts, a phase difference of 140° for green light of 5,460 angstroms has been measured. If amplitude modulation is desired, a polarizer is placed in the beam of the phase-modulated output wave. The beam emerging from the polarizer is amplitude-modulated.

SURGICAL INSTRUMENT SEES WITH ULTRASONICS

An operation on the eye of 11-year-old James Cassidy, son of an Air Force staff colonel, publicized the existence of a new retrieval probe that, in effect, uses ultrasonics to see its object. The probe consists of a 1-millimeter-diameter crystal transducer, mounted behind the tips of miniature eye forceps. The reflection from the object (in this case, a brass .22 caliber shell fragment) is displayed on the screen of a 1-inch cathode-ray tube, much like a miniature radar. The surgeon can observe the approach of the forceps to the object to be removed, and close the forceps at the right moment.

The operation was performed by Dr. Nathaniel Bronson, of the Walter Reed Army Hospital. The instrument was developed by scientists of Smith Kline Instrument Co., in cooperation with Dr. Bronson.

RAPID RECORDING METHOD USES TAPE ELECTRETS

A technique that makes it possible to record processes lasting only 10^{-7} second was described by Dr. Gy Almassy, of the Research Institute for Telecommunication in Budapest, in a paper read at the Sixth International Instruments & Measurements Conference in Stockholm.

The recording is on a plastic tape, which is polarized permanently to

continued on page 14

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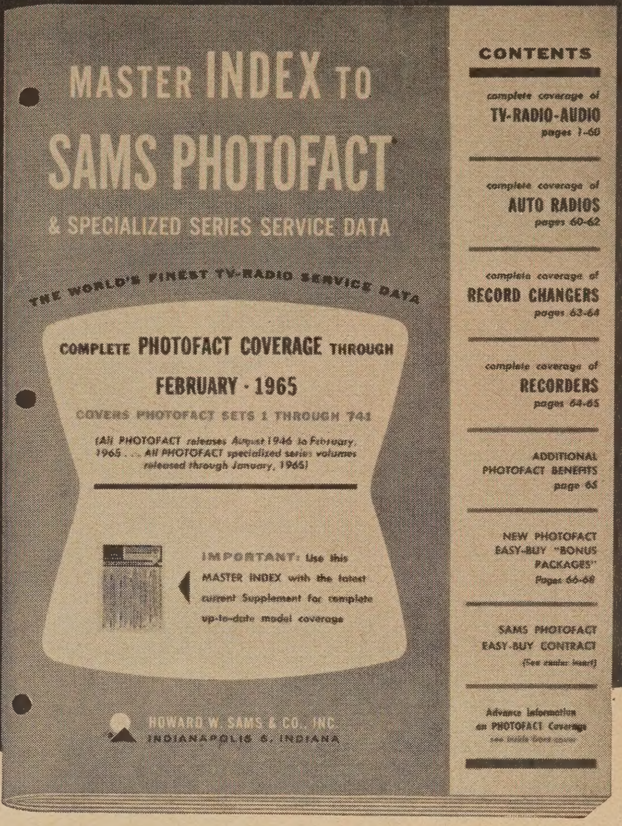
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pages 1-60
complete coverage of
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pages 60-62
complete coverage of
RECORD CHANGERS
pages 63-64
complete coverage of
RECORDERS
pages 64-65
ADDITIONAL PHOTOFACT BENEFITS
page 65
NEW PHOTOFACT EASY-BUY "BONUS PACKAGES"
Pages 66-68
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CARD REMOVED

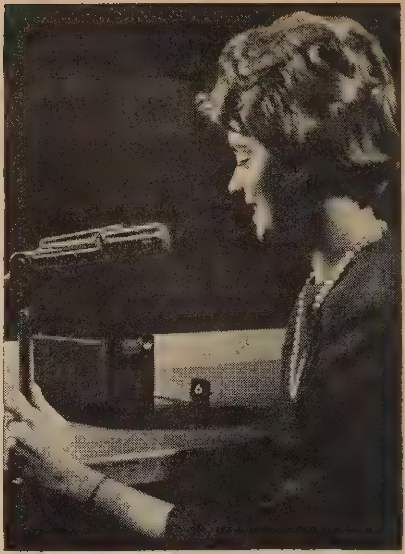
make it an electret. Electrets, the electrostatic analog of permanent magnets, are pieces of wax or plastic with a permanent positive charge on one surface and a permanent negative charge on the other (see RADIO-ELECTRONICS, January 1950).

Signals are recorded on the foil surface by sparking, creating an electric charge on the surface which can be read electrostatically, or visually by applying powder. The signal can be stored indefinitely. Recording time is limited only by the sparking speed of air, according to Dr. Almassy.

One interesting feature of the paper was that many of the scientists attending the meeting had to be persuaded that electrets did in fact exist, before they were willing to consider the merits of the process.

SEX-CONSCIOUS COMPUTER CLAIMED BY SPERRY RAND

A tiny computer that can distinguish between such spoken English words as "six," "sex" and "sick" was described at the Northeast Electronics Research and Engineering Meeting by George Spalding and Robert Hawkins.



The SCEPTRON pattern-recognizer doing its best to distinguish between "six" and "sex."

The computer is a development of SCEPTRON, described fully in RADIO-ELECTRONICS, April 1964. According to Sperry scientists, the development could well be the nucleus of future voice-commanded machines, which must distinguish sharply between similar-sounding English words. The computer then could respond to spoken commands without making it necessary for a programmer to translate into "machine languages," as is now necessary, to "talk to" a computer.

CALENDAR OF EVENTS

11th Annual Symposium on Reliability and Quality Control, Jan. 12-14; Fountainbleu Hotel, Miami Beach, Fla.

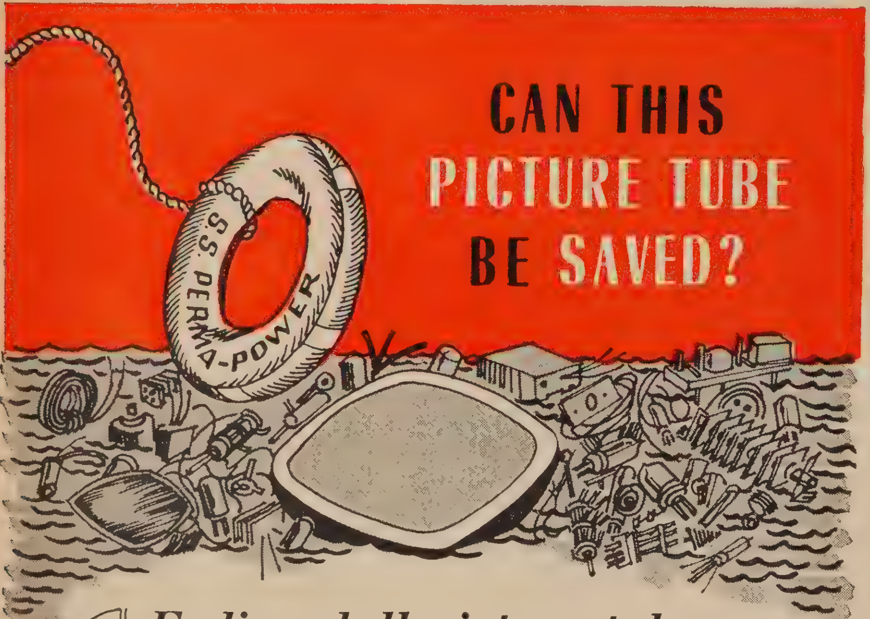
1965 Washington Hi-Fi Music Show, Feb. 12-14; Sheraton Park Hotel, Washington, D.C.

12th Annual International Solid-State Circuits Conference, Feb. 17-19; Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

International Exhibition of Electronic Components, April 8-13; Parc des Expositions (Fairgrounds), Porte de Versailles, Paris.

WANT A VIDEO RECORDER?

The first home video tape recorder has been offered to the world—and in kit form at that! Wesgrove Video Recorders of Worcester, England, announces the VKR 500, which it states is available for immediate shipment at $392 complete with full instructions. The manufacturer states the VKR 500 uses the well known direct-recording principle, as used in all normal audio recorders, and manages a bandwidth of 2 mc on ordinary ¼-in. magnetic tape. It is said to have speeds of 7.5, 10 and 12.5 ft per second, with two sound and



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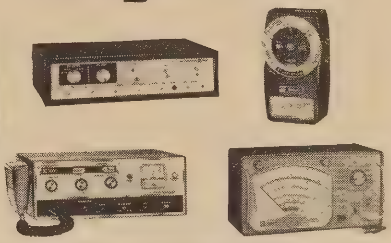

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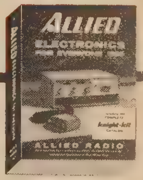

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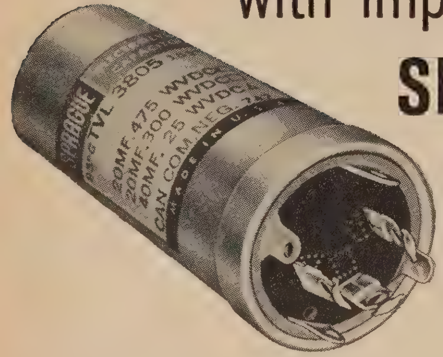

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NEWS BRIEFS continued

two video tracks. The sound is recorded by FM.

By press time, it was impossible to ascertain how well the device works, or if anyone on this side of the water had succeeded in putting one together. However, the British company does have the distinction of being the first to offer a home-type video tape recorder to the general public.

TRANSISTOR NOISE ELIMINATOR DISCOURAGED BY POLICE

Police of Bogota, Colombia, were at last reports hunting for a killer who has shot at least 6 persons playing transistor radios in public places.

The police were reported to be patrolling plain-clothed with small transistor radios, while all other citizens were warned against carrying or playing transistor radios on the city's streets. The police did not state whether the ban would be made permanent, to prevent driving other Bogotans to desperation.

CALIFORNIA TURNS DOWN PAY TV SYSTEM

The November elections spelled doom to subscription television, with a vote more than 2-to-1 against it.

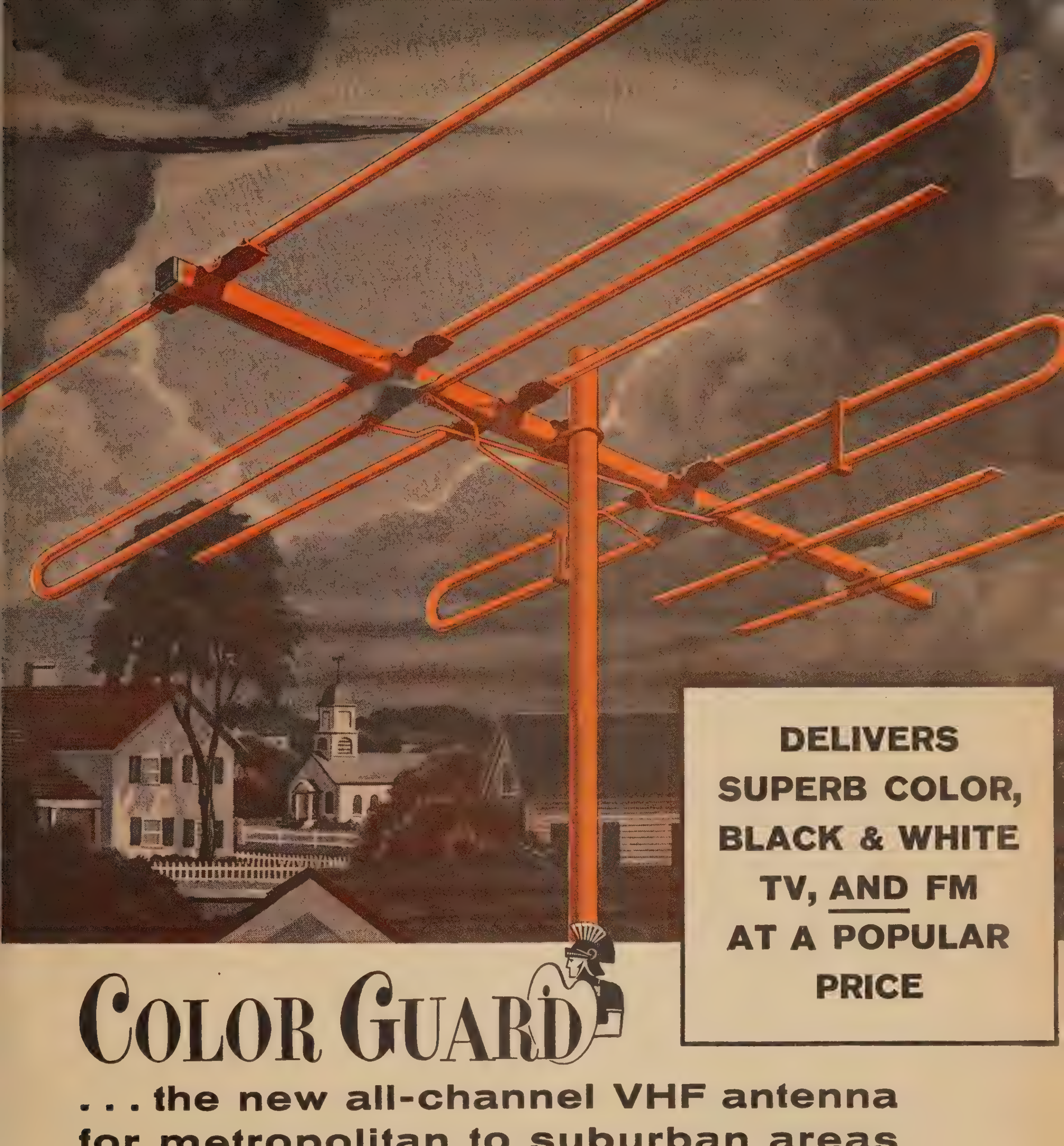
Subscription Television, Inc., moved to file suit with the State Supreme Court to prevent the proposition being declared a legally passed law, believing it to be unconstitutional, as violating freedom of speech and equal protection clauses of the Constitution, and as being discriminatory, as well as violating other laws.

The pay-TV system had been operating experimentally in Los Angeles and San Francisco, and was the largest pay-TV venture so far.

The size of the vote was probably due to two factors: an intensive and expensive publicity campaign by theater owners, and the fear of the voters that they would eventually have to pay to watch the same TV shows that they now get free.

BRIEF BRIEFS

Electronic image intensifiers added to telescopes triple the observable brightness of an image, according to a joint announcement of the Carnegie Institution and the Radio Corporation of America. The image intensifier has been used with great success on electron microscopes (RADIO-ELECTRONICS, Dec. 1964, p. 8). Only 3 inches in diameter and 5 inches long, the intensi-



DELIVERS SUPERB COLOR, BLACK & WHITE TV, AND FM AT A POPULAR PRICE

COLOR GUARD

. . . the new all-channel VHF antenna for metropolitan to suburban areas

It takes a good antenna to deliver good color TV pictures. Color carriers are not only weak, but phase-modulated. For this reason, antenna gain must be not only high, but flat across the entire frequency spectrum.

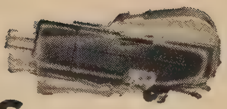
Because Color Guard antennas meet the stringent requirements of color TV, they're better for black & white and FM stereo reception too. Yet you can sell a Color Guard antenna for as little as $9.95 list.

Outstanding among the Color Guard series is the Coaxial Color Guard. Coaxial cable is highly recommended for color installations. It maintains constant impedance match (no ghosts or color changes), won't pick up interference, and is impervious to weather conditions. While most antennas require a separate matching transformer for use with 75-ohm coax, the Coaxial Color Guard is already matched to 75 ohms.

Any of the Color Guard antennas can be used to provide excellent FM stereo reception. All you need is Jerrold's inexpensive Model TX-FM splitter and you can feed a TV and an FM set simultaneously from the same Color Guard. See your Jerrold distributor or write for complete information on Color Guard—the perfect antenna for all your customers—from metropolitan to suburban reception areas.

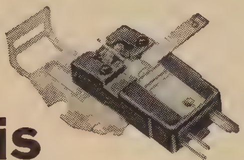
Jerrold Electronics,
Distributor Sales Division, Phila. 32, Pa.

JERROLD
ELECTRONICS



This one is twice as safe.

When Sonotone designs a retractable cartridge, you can be sure it offers something extra. Like other retractable cartridges, the new Sonotone "21TR" withdraws into the safety of the arm to avoid bumps and bruises. Further, it has "bottoming" buttons which act as shock absorbers between the needle assembly and the record. Unlike other retractables, the "21TR" features the exclusive Sono-Flex® stylus, which can be dropped or mauled and still continue to provide superior performance. The high-output "21TR" is a direct replacement for the thousands of record players requiring a quality retractable cartridge.



This one is twice as safe and twice as compliant.

The new Sonotone "23T" offers performance specifications never before available in a budget-priced ceramic cartridge—plus record protection. High compliance of 10; channel separation of 24 db; output voltage of 0.38; low tracking force of 2 to 4 grams make it the ideal replacement in quality stereo phonographs. Performance is only half the story of the "23T". This new cartridge features "bottoming" buttons and the flexible Sono-Flex® needle. Another Sonotone cartridge, the "22T," offers the high performance of the "23T" with a slightly higher output. Both feature the Sono-Flex plus a unique snap-in mounting bracket, for rapid replacement without tools.

Both are direct replacements for popular makes

...and themselves.

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NEWS BRIEFS continued

fier will enable a 60-inch reflector telescope to take photographs of faint star images or other objects now obtainable only with 180-inch diameter telescopes.

Ticks broadcast by National Bureau of Standard stations WWV, WWVH and WWVB were retarded 1.0 msec at 0000 UT on Oct. 1, 1964, while Navy station ticks were advanced 1.6 msec. Effective Nov. 1, 1964, WWVH no longer gives forecasts of propagation in the North Pacific. They will continue to be given every 5 minutes from station WWV.

RCA announced the production of its 3 millionth color TV picture tube late in 1964. The company plans to produce 1.5 million color tubes in three sizes (21, 19 and 25 in.) during 1965. Combined industry output is expected to reach 2.2 million units in '65.

Gen. David Sarnoff warned some 4,000 engineers and scientists at the Joint Computer Conference in San Francisco that the computer industry is turning into "a technological tower of Babel." Stressing the need for compatibility and standardization, he said, "There are, by conservative count, more than 1,000 programming languages, and there are languages within languages . . ."

Too much TV watching can produce a "tired-child syndrome" with symptoms of chronic fatigue, loss of appetite and headache and vomiting, it was reported to the American Academy of Pediatrics, based on a study at two Air Force hospitals. The symptoms disappeared when the childrens' watching was terminated. But many parents were unwilling to forego watching and some children drifted back into their old practices. The symptoms then recurred.

The IEEE, at the National Electronics Conference in Chicago, awarded a plaque to Marvin Camras of the Illinois Institute of Technology for his pioneering work in magnetic recording, naming him "the scientist who has made the most outstanding contribution to the consumer electronics industry."

"A trillion watts of laser power in pulses of 10^{-11} second seems a quite practical goal," says Charles H. Townes, who received the Nobel Prize for his work on masers and lasers.

High-speed experimental data communications system developed by Bell transmits black-and-white facsimile 16 pages per minute, with 100-line-per-inch definition. Present systems send 1 page in 6 minutes. END

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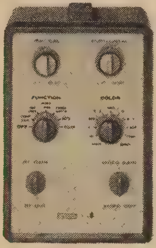

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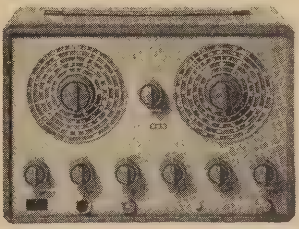

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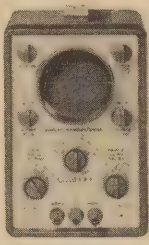

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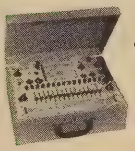

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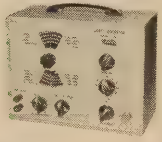

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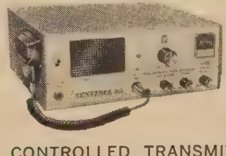

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FM —up to 75 miles

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VHF—up to 150 miles
UHF—up to 90 miles
FM —up to 60 miles

Model
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Description
9 Active Cells
VHF—up to 100 miles
UHF—up to 40 miles
FM —up to 40 miles

Model
LPV-VU6

List
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Description
6 Active Cells
VHF—up to 75 miles
UHF—up to 25 miles
FM —up to 30 miles

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Description
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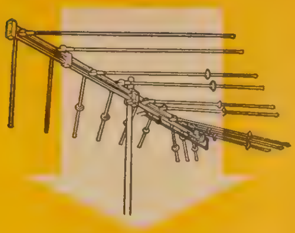


ou can't satisfy today's complex VHF/ UHF/FM reception needs with yesterday's ntennas. Today's "VU" TV sets call for a ingle all-powerful all-band antenna that lelivers the signals you need for picture-erfect reception on all channels 2 to 83—lus FM Stereo.

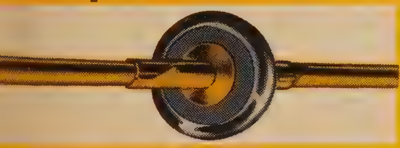
That's why smart installers and dealers re switching to the new JFD LPV-VU. This newest antenna advance from the JFD Champaign, Illinois R&D Laboratories, eams (1) the acclaimed JFD Log-Periodic oncept with (2) a totally new antenna de-ign principle—the *capacitor-coupled elec-ronic dipole.*

Result? More driven elements than ever efore possible for the most efficient per-ormance ever on VHF, UHF, FM/Stereo —from *one* antenna, **with one lead-in.**

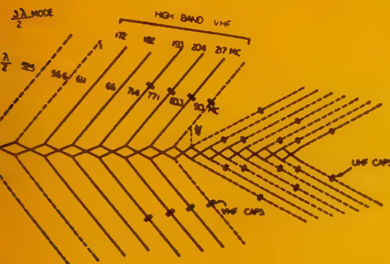
And you can choose from five gold alo-ized LPV-VU Log-Periodics to satisfy very location, any budget: model PV-VU-18, LPV-VU-15, LPV-VU-12, PV-VU-9 and LPV-VU-6.

New from JFD—another outstanding ad-ance in dipole design, the *capacitor-cou-led electronic dipole!*

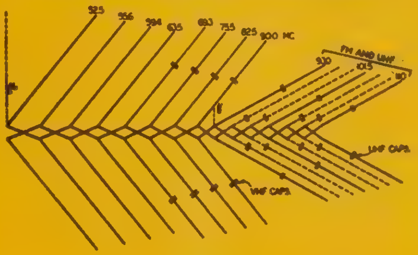
By introducing parallel plate capacitors nto predetermined positions along the di-oles, and by precisely adjusting the value f each capacitance:



More dipoles are made to resonate on the high VHF band with a corresponding increase in gain.



2. *Higher mode* operation in UHF band achieves higher gain on channels 14 to 83—equal or better than that of parabolics. Improves FM stereo performance.
3. *More uniform* gain across each band, with narrower beamwidths. High front-to-back ratios greatly improve ghost rejection—insure excellent color fidelity.

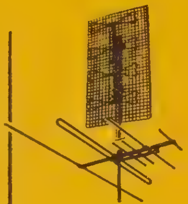


PLUS . . .

1. *Patented frequency independent Log-Periodic design* maintains same high performance efficiency regardless of station or band tuned in.
2. *Only one downlead needed.* A JFD AC80 splitter, included with each LPV-VU, permits you to tie directly into VHF, UHF and FM set inputs.
3. *New low-impedance twin crossarms* function as crossed feeder harness. Step up gain and improve signal transfer.

LPV-VU OFFERS NEW *MECHANICAL ADVANCES, TOO!*

■ Twin square aluminum crossarms. ■ Stainless steel terminals. ■ Oversized unbreakable Celanese "Fortiflex A" insulators. ■ Solid aluminum bus bar transformers. ■ Tubular crossarm supports on larger LPV-VU's. ■ Double U-bolts with 4 serrated-gripping profiles for 6-inch gripping span. ■ Electrically conductive gold alodizing.



INSTALLER BEWARE!

Don't spoil your

VHF reception!

Addition of a separate UHF antenna to a present VHF installation may cut the VHF signal being delivered to your set. Incoming signals from a VHF transmitter may be scattered from the UHF antenna. Scattering produces less signal and multiple signals which cause ghosts.

SO WHY USE TWO WHEN *ONE LPV-VU* WILL DO?

Install the *all*-channel JFD LPV-VU and get the best VHF and UHF from *one* antenna with *one* down-lead!

A SPACE-AGE PRODUCT OF THE WORLD'S GREATEST TV/FM ANTENNA LABORATORIES

This newly completed laboratory, located on a ten acre site in Interstate Research Park, in Champaign, Illinois (home of the University of Illinois) marks a milestone in antenna history. It is dramatic proof of JFD leadership in antenna technology. Its fully staffed and equipped engineering staff, under the supervision of Dr. Paul E. Mayes, is blazing new trails in antenna design. This priceless know-how is built into each LPV-VU you sell.

The JFD LPV-VU is adapted from the geometrically derived Log-Periodic antenna formula developed by the Antenna Research Laboratories of the University of Illinois.

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TV SERVICEMAN'S COLOR BOOK FREE

New Triad Color TV Replacement Guide For Professional TV Men Whose Favorite Color is Savings Green

Triad's new 10-page color TV replacement guide is the most thorough, up-to-date reference of its kind. With it, you can immediately determine exactly which Triad flyback, vertical output, power transformer or deflection yoke will replace corresponding parts in well over 1200 models made by RCA, Motorola, Admiral, General Electric, Magnavox, Olympic, Philco, Silvertone and a dozen other manufacturers. Get your copy and depend on the most complete line of color TV replacement transformers available today to simplify and brighten up your service calls. Your increased efficiency will mean greater convenience and savings for both you and your customers. If two-way savings green and profit black are your pet colors, write Triad Distributor Division, 305 North Briant Street, Huntington, Indiana.

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TV REPLACEMENT
GUIDE

TRIAD DISTRIBUTOR DIVISION
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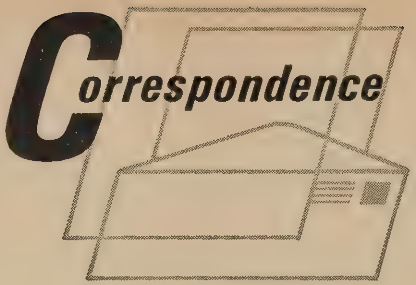


Correspondence

INVENTOR CORRECTS CIRCUIT

Dear Editor:

I am writing to inform you of errors in the Steup (pronounced *Stoip*) detector circuit in your November issue, under Noteworthy Circuits ("New Detector for SSB, CW and AM").

As the inventor of the circuit, I would like to correct the mistakes for the readers of your fine publication.

The i.f. filter choke should be 1 *milli*henry, not 1 *micro*henry.

The capacitor for slow-agc position should be 0.1 μf, not 1 μf.

The 1,000-ohm resistors in the plate and screen are for isolation. Exact values will depend on supply voltage, other circuits, etc.

JOHN E. STEUP, SR.
Wichita, Kan.

WANTS SQUARE-WAVE MAKER

Dear Editor:

I subscribe to RADIO-ELECTRONICS and enjoy reading it every month.

In your May issue you had a particularly interesting article, "A Lab-Quality Audio Generator," by Jon Idestam-Almquist. I agree with Benjamin Resella (August Correspondence column): I'd like to see an article on a good square-wave adapter to use with the generator.

I would welcome more audio articles in coming issues.

AL HAWKES
Westbrook, Me.

6-VOLT TRANSISTOR IGNITION SYSTEM

Dear Editor:

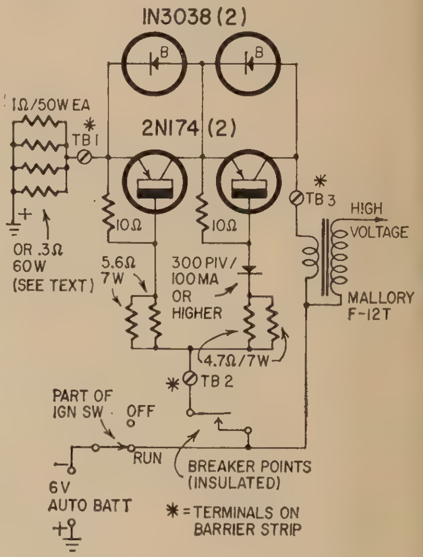
I have constructed a 6-volt, positive-ground version of my transistor ignition system described in the April issue of RADIO-ELECTRONICS.

Here are the things to consider when constructing such a system:

1. The ignition points must be insulated from the chassis of the car. In some automobiles, this may be next to impossible. However, an insulating kit may be purchased from a number of transistor ignition manufacturers for some automobiles.

2. The 6-volt system requires a ballast of 0.25 to 0.3 ohm, not readily available from electronic supply houses. Four 1-ohm resistors in parallel were used in my 6-volt version.

3. The emitter and collector lead lengths become critical. Wire that is too long or too thin will introduce more resistance and lower the collector current. The ballast resistance and lead-wire resistance should be chosen to give between 9 and 10 amps of collector current.



4. The value of the base bias resistors must be cut in half. This can be done by using two resistors of the original values in parallel. The point current will be double that in the 12-volt circuit.

The 6-volt version was tried successfully on a 1955 Thunderbird, but no reliability or life tests could be made in such a short time. The schematic is for readers who would like to experiment.

JOHN R. GYORKI
Allen Park, Mich.

CHEERS FOR HOMER D.

Dear Editor:

Congratulations to Homer L. Davidson for his comprehensive articles on rotator repairing.

As a subscriber to five electronics magazines I have been waiting for such an article. Bouquets to RADIO-ELECTRONICS.

The only addition is to stress the most common trouble in rotator service: capacitor failure. This can be detected in its first stages by slow motor operation and then no operation at all when the capacitor has lost most of its capacitance. When the capacitor is in series with one motor winding, the phase-shift difference in the windings allows the motor to turn in the direction chosen by the selector. When the capacitor loses most of its capacitance, there is no phase difference and thus no rotation.

continued

RCA Victor Color TV is the personal choice of more TV servicemen than all other makes combined!

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±10% DIPPED MYLAR*
PAPER BYPASS CAPACITORS
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AKU-102 KIT

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5 ea.	.0022	600V	5 ea.	.022	600V
5 ea.	.0033	600V	20 ea.	.047	600V
5 ea.	.0047	600V	20 ea.	.05	600V
10 ea.	.005	600V	20 ea.	.1	600V

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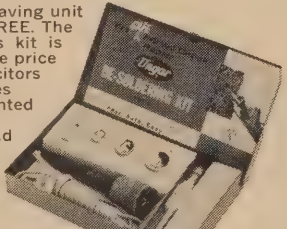
PLUS
famous UNGAR #270
DE-SOLDERING KIT

Complete with Instruction Manual and two extra tips.

This labor-saving unit is offered FREE. The cost of this kit is less than the price of the capacitors alone! Makes work on printed circuits as easy as hand wired units.



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CORRESPONDENCE continued

As a rotator repair depot serving eastern Ontario for Alliance and Crown rotators, I can agree with Mr. Davidson that the rotator repair business is a part of TV antenna work that both the TV servicers and TV installers tend to pass on—to our advantage.

H. JARRETT
Cornwall, Ont.

WATT-SECONDS AIN'T LIGHT

Dear Editor:

Although I enjoyed your article, "Servicing Speedlights" in the August issue, I can hardly believe Mr. Lemons is much of a photographer. He writes: "The light energy output is calculated by photographers in *watt-seconds.*" This is not the case; watt-seconds are not an indication of the light-energy output. The watt-second rating of any speedlight cannot tell you how much light the unit will put out. ECPS and BCPS (*efficient candle power seconds* and *beam candle power seconds*) are the units used.

If all electronic flash units used the same flashtubes, circuits and reflectors, the watt-second rating would be valid.

A1C ERIC S. EVANS
APO 103, San Francisco, Calif.

[True. The watt-second rating is a measure of the energy *available* to the flash tube. But regardless of the flash tube used, the watt-second figure gives some idea of the power of the equipment, like an audio amplifier rated at so-and-so-many watts. That rating doesn't take into account the fact that speakers with efficiencies of 1% to 50% may be used with the amplifier, and thus that the ultimate *acoustical* power will vary accordingly. Still, we continue to rate amplifiers alone, with standardized resistive loads. That gives us a rough comparative scale for gaging what might be called the "potential" of a particular system, even though the numerical power rating is valid only for the amplifier alone under controlled conditions.—*Editor*]

Wayne Lemons Replies:

To the charge of "not being much of a photographer" I plead guilty, but to the charge of making a false statement, I'm ready to stand trial.

Mr. Evans makes one of his own, when he says, "watt-seconds are no indication of the light energy output." Please let me quote from Kodak's Data Book *Flash Pictures,* 1962 edition, speedlight section, pp. 32–33:

> "Electrical energy output is the most important single factor determining how much light a tube puts

RAVE REVIEW
ON SONY 600

Radio-Electronics Magazine June, 1964 says:

"This recorder has some very good specifications and, although its price is above the 'cheap' range, one does not readily believe such excellent specs for a 4-track machine until they prove out. This machine fulfilled its promise. With it, you can tape your stereo discs and play them back without being able to detect any difference, which is saying something. The physical design of this unit is good, for either permanent installation or the most complete portability.

"The footage indicator *is* a footage indicator, not merely a place spotter, and it keeps its count with all normal tape movements. Independent control of left and right channels, so one can be operated in record, while the other is in playback, enable the unit to be used for an endless variety of 'special' effects.

"Playback and record functions are completely separate, so that a recorded program can be monitored immediately. Microphone and auxiliary inputs can be mixed for combination and re-record effects. First stage amplification uses transistors, while the main amplification uses tubes—a good marriage in this particular design.

"The mikes are very good, compared with most of the 'inexpensive' types used with home recorders. Extremely good realism is possible for home recordings. I had my family 'act natural' in front of the two-mike combination and the playback was unbelievably real.

"The Sony 600 will naturally take a little playing around to find out how to do various 'extra' things you may want. But when you get to know it, you'll find it a very versatile instrument. It's a recorder with which familiarity brings confidence."

Norman H. Crowhurst

For further information, or complete copy of the above test report, write Superscope, Inc. "600 Test Report G, Sun Valley, Calif.

Now enter the world of the professional. With the Sony Sterecorder 600, a superbly engineered instrument with 3-head design, you are master of the most exacting stereophonic tape recording techniques.

Professional in every detail, from its modular circuitry to its 3-head design, this superb 4-track stereophonic and monophonic recording and playback unit provides such versatile features as: ■ vertical and horizontal operating positions ■ sound on sound ■ tape and source monitor switch ■ full 7″ reel capacity ■ microphone and line mixing ■ magnetic phono and FM stereo inputs ■ 2 V.U. meters ■ hysteresis-synchronous drive motors ■ dynamically balanced capstan flywheel ■ automatic shut off ■ pause control and digital tape counter—all indispensable to the discriminating recording enthusiast. Less than $450,* complete with carrying case and two Sony F-87 cardioid dynamic microphones.

Multiplex Ready!

SONY SUPERSCOPE® The Tapeway to Stereo

* ***Yes, less than $450!***

Sony tape recorders, the most complete line of quality recording equipment in the world, start at less than $79.50.
For literature or name of nearest dealer, write Superscope, Inc., DEPT. 58, Sun Valley, Calif. *In New York, visit the Sony Salon, 585 Fifth Avenue.*

out; many electronic flash units are therefore rated in terms of watt-seconds."

Mr. Evans contends that watt-second rating is no indication whatsoever and Kodak, on the other hand, says it is the most important single factor in determining light output.

Actually, watt-seconds was the only rating used for speedlights at first; later, candlepower (effective and then beam) came into use. Kodak goes on to say that the candlepower rating is more useful for determining guide numbers since it includes more factors. Still, in the next paragraph they say:

"In order to get a truly meaningful guide number for his own use, the owner of an electronic flash unit should determine one by actual photographic test."

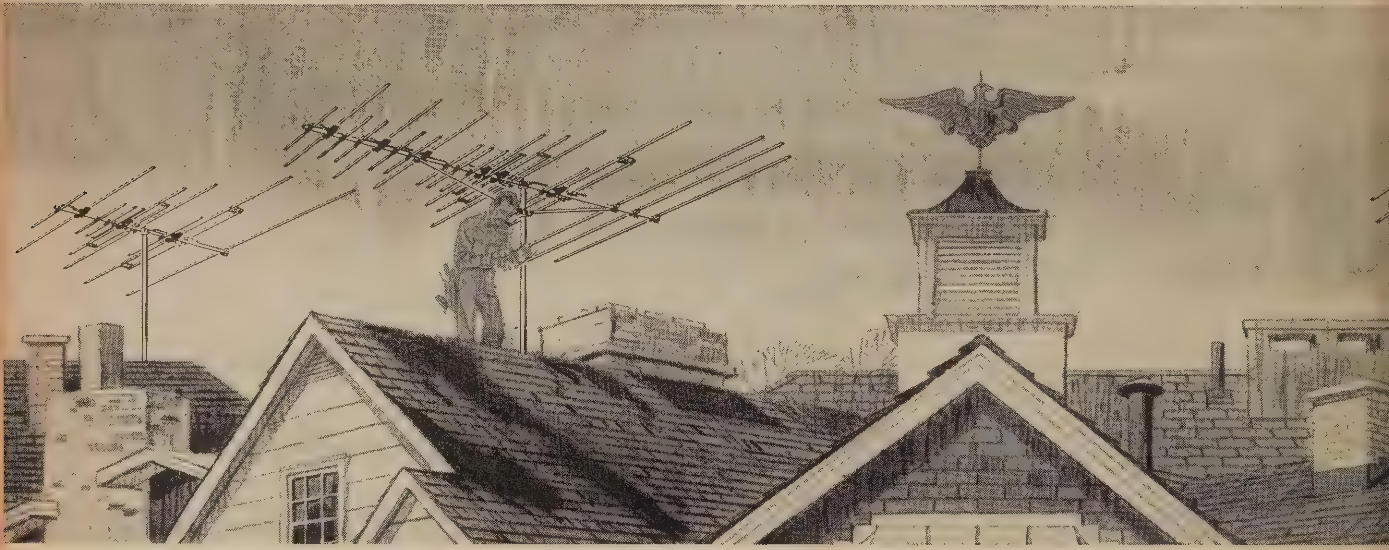
It appears then that I should have said, "The light energy output is calculated by photographers by *trial and error.*"

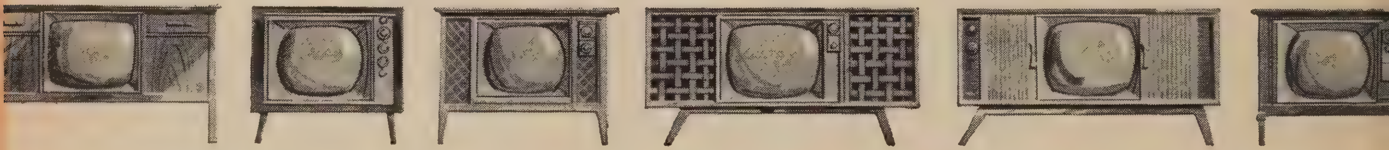
We still prefer watt-seconds as a measurement for servicing. At least this can be calculated with a voltmeter and capacitance bridge, if necessary, I know of no electronic technicians, who have candlepower measuring equipment.

While we're on the subject of speedlights, I'd like to commend Mr. Pawlowski's letter in the October issue concerning lethal speedlight voltages. *TAKE NO CHANCES WHATSOEVER—YOU CAN GET KILLED.* Discharge all capacitors through a 5,000–10,000-ohm, 10-watt resistor (this reduces the loud report and eliminates burnt screwdriver ends), and then completely short the capacitors and leave the short connected until tests on other parts are made.

If you insist on being awe-inspired, just short an insulated screwdriver directly across a 16-μf capacitor charged to 2,500 volts. It's a real experience and one that will put meaning into Mr. Pawlowski's warnings.

WAYNE LEMONS
Buffalo, Mo.





Why are most Color Television Sets

BECAUSE EXPERIENCED COLOR TV DEALERS KNOW THAT WINEGARD COLORTRONS ALWAYS DELIVER THE BEST COLOR PICTURES POSSIBLE!

And it's just plain, common sense . . . *when a man invests $400-$1000 or more in a color TV set, he expects—and deserves—the finest possible color reception!*

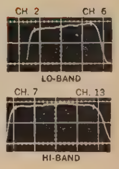
Most people who demand the finest in color TV reception choose Winegard Colortron. Here's proof:

Look on top of the largest retail stores in the country . . . they demonstrate their sets connected to Winegard antennas; or look on the homes of the famous TV and movie stars in Hollywood; or on the studio buildings of all three major TV networks; even atop the Whitehouse in Washington. Wherever the best color is seen, you'll see a Winegard Colortron . . . it's *the* TV antenna made for color.

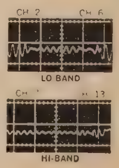
What's behind Colortron's Superior Performance? *Balanced Design!* Just what is Balanced Design? It's the perfect combination of high gain, accurate impedance match, complete band width, and pinpoint directivity . . . and only Colortron has it!

For example:

Gain and Bandwidth—A superior color antenna must have high gain and complete bandwidth. But the response must be flat if it is to be effective. Peaks and valleys in the curve of a high gain antenna can result in acceptable color on one channel and poor color on another. *No all-channel VHF-TV antenna has more gain with complete bandwidth across each and every channel than Colortron.* Look at the Colortron frequency response in this oscilloscope photo. Note the consistently high gain on all channels. Note the absence of suck-outs and roll-off on end channels. Note the flat portion of the curve . . . there is less than ½ DB variance over any channel.



Impedance Match — the two 300 ohm "T" matched Colortron driven elements have far better impedance match *than any antenna using multiple 75 ohm driven elements.* The Colortron transfers maximum signal to the line without loss or phase distortion through mismatch. The oscilloscope photo here shows the Colortron



TAPER LIKED UNIVERSAL PREAMP

Dear Editor:

I wish to thank you for the "Universal Tape-Play Preamp" in your October issue. I have been "bugged" to wits' end by the noise and hum in my tape system for a couple of years now, and this is the first really good design to come along. The low distortion and frequency response are great. The only alteration I made was in the equalization network. It didn't seem to have enough bass with my Knight heads. It is easy to build and I recommend it to any one with the same problem. Thanks again.

DAVID A. GOETZ

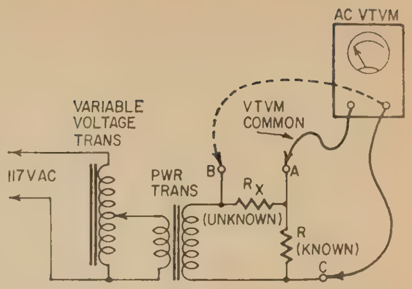
Pittsburgh, Pa.

THERE'S AN EASIER WAY

Dear Editor:

I just finished reading Noteworthy Circuits in your November issue. In "Measuring Ultra-High Resistances" I think that Tom Jaski missed the simplest approach to his circuit. The calculation could be made simpler for all cases if he had simply connected the vtvm common lead to point A and then made his measurements on each resistor individually. The ratio of the two voltages is then directly equal to the ratio of the resistors.

$$\frac{V_{AB}}{V_{AC}} = \frac{R_x}{R}$$



In simpler terms, if the voltage across the unknown resistor is 1,000 times the voltage across the known resistor, then the unknown resistor is 1,000 times as large as the known.

DAVID C. YEOMAN
W0QWY

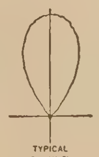
Todville, Iowa

END

connected to Winegard Antennas?

VSWR curve (impedance match). No current VHF-TV antenna compares with it across all 12 channels.

Directivity—An antenna with sharp directivity and good signal-to-noise characteristics is necessary for perfect color. Extraneous signals, picked up at the back and sides, produce objectionable noise and ghosts in black and white reception. But in color TV, they frequently ruin reception. *Winegard Colortron has the most ideal directivity pattern of any all-channel VHF antenna made.*


TYPICAL CHANNEL

The Unsurpassed Performance of Balanced Design is Matched Only by the Colortron's Unsurpassed Construction!

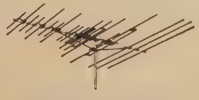
Colortron has been engineered for maximum strength, minimum weight and minimum wind loading. The result is a streamlined, lightweight antenna that stays stronger longer. Colortrons have even been wind tested to 100 m.p.h.

Advanced-design snap lock hardware makes Colortron the easiest antenna to install. Winegard Colortron also has the finest *Gold Anodized finish* of any TV antenna made.

Winegard Helps You Sell...With *More* National Consumer Advertising *Than All Other Brands Combined!* Look for Winegard ...on AFL Football over ABC (over 1,500,000 viewers per game)...in Life Magazine (over 13,000,000 readers per issue) ...in Parade (the big Sunday supplement with 21,000,000 readers per issue).

This is the Season for TV buying... The season for you to stock up on Winegard Colortrons. Remember... over 2,000,000 Color TV Sets will be sold this year and *the* antenna *made for color* TV is Winegard Colortron. Order today!

COLORTRON ANTENNA
Model C-44 • Gold Anodized • $64.95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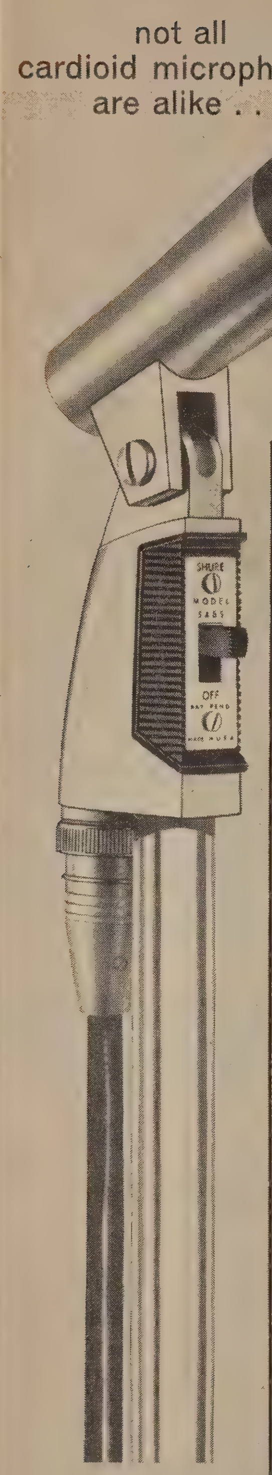
cardioid microphones
are alike . . .



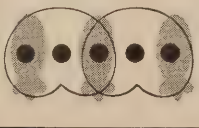
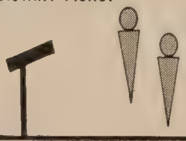
only the

SHURE UNIDYNE III

TRUE CARDIOID UNIDIRECTIONAL DYNAMIC MICROPHONE SOLVES ALL THESE COMMON MICROPHONE PROBLEMS!

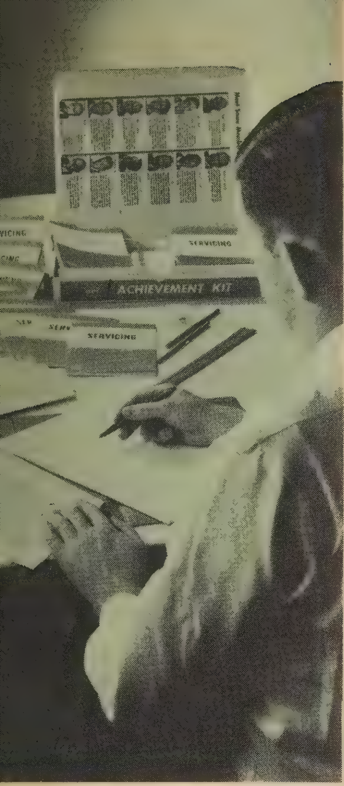
MODEL 545S

PROBLEMS CAUSED BY INEFFICIENT REJECTION OF UNWANTED SOUNDS BY THE MICROPHONE

SITUATION	PROBLEM	CAUSES	SOLUTION
REFLECTIONS	Feedback occurs where a so-called "cardioid" microphone is used and the speakers are placed to the rear of the microphone. A common occurrence in churches, auditoriums, and meeting rooms.	Sound bounces off hard surfaces on the walls, floor and ceiling, in and around the audience area and the microphone used is not effective in rejecting these sounds at all frequencies, and in all planes about its axis.	The Unidyne III eliminates this problem because of effective rejection of sound at the rear of the microphone with uniformity at all frequencies. Sounds bouncing off the floor or other reflective surfaces that reach the rear of the Unidyne III are rejected.
COLUMN LOUDSPEAKERS	Unexplained feedback. Column loudspeakers are used to distribute sound more evenly to the audience in churches and auditoriums.	While column speakers direct the sound toward the audience, they also have side and rear sound lobes which may reach the microphone. Feedback occurs when the rear and side sound lobes of the speakers coincide with the rear and side lobes of a so-called "cardioid" microphone.	The Unidyne III solves this problem because it has no rear or side lobes. Thus it rejects the side and rear lobes of the sound column speakers.
REVERBERANT BOOM BOOM	A disturbing, echoing effect of low frequency sound often found in churches, large auditoriums, and arenas.	The particular "cardioid" microphone used fails to retain its unidirectional characteristics with low frequencies. In addition, its front response tends to accent low frequencies of the desired sounds. These factors result in pickup and reinforcement of the low frequency reverberation and boominess characteristic of many halls.	Using the Unidyne III Microphone will solve the problem because it maintains a uniform pattern of sound rejection in all frequencies, even as low as 70 cps. The frequency response also has a controlled roll-off of the low end. This prevents reinforcement of the low frequency reverberation and diminishes the effect of a boomy hall.
PROBLEMS CAUSED BY THE MICROPHONE'S INEFFECTIVENESS IN PICKING UP THE DESIRED SOUND			
GROUP COVERAGE WITH ONE MICROPHONE	A single microphone does not provide uniform coverage of a group. This is commonly experienced with choral groups, quartettes, instrumental combos, and speaker panels.	The particular "cardioid" microphone used lacks a uniform pickup pattern, so that persons in different positions within the general pickup area of the microphone are heard with varying tonal quality and volume.	The Unidyne III affords uniform pickup of the group with a resulting consistency in volume and sound quality among the members of the group.
USING MULTIPLE MICROPHONES 	Variation in the pickup level and tonal quality exists throughout the broad area to be covered. This may occur in stage pickup of musical and dramatic productions, panels and audience participation events.	The pickup pattern of the microphones used is too narrow, causing "holes" and "hot spots". The off-axis frequency response of the microphones also varies.	The Unidyne III permits a smoothness in pickup as the true cardioid pattern gives broad coverage with uniformity throughout the coverage area. This eliminates "holes", "hot spots", and the variations in sound quality and permits blending many microphones with ease.
DISTANT PICKUP 	Too much background noise or feedback results when working with microphone at desired distance from sound source.	So-called "cardioid" and particularly long range microphones being used are less directional with lower frequencies. In addition, they have lobes or hot spots that pick up sound at the rear, resulting in the background noise or feedback problem.	Use the Unidyne III to gain relatively long range with effective rejection of sound at all frequencies at the rear of the microphone.

SHURE
BROTHERS, INC.
222 Hartrey Ave.
Evanston, Illinois

U.S. Patent D190, 864; other patents pending.



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Delivered to your door—everything you need to make a significant start in the Electronics field of your choice! This new starter kit is an outstanding, logical way to introduce you to NRI training kits . . . an unparalleled example of the value of NRI home-study training. What's in it? Your first group of lesson texts; a rich vinyl desk folder to hold your study material; the industry's most complete Radio-TV Electronics dictionary; valuable reference texts; lesson answer sheets; pre-addressed envelopes; pencils; pen; engineer's ruler, and even postage. No other school has anything like it.

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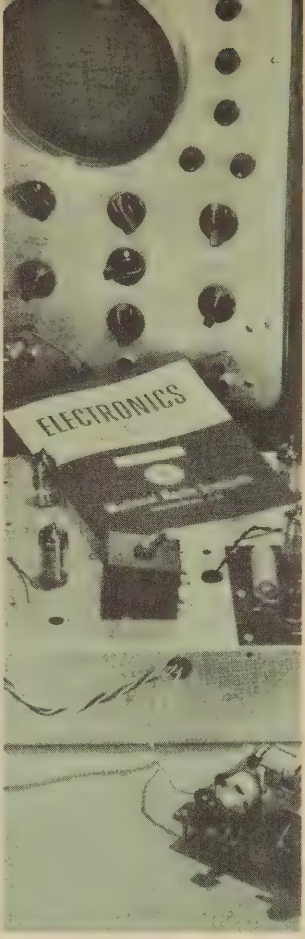
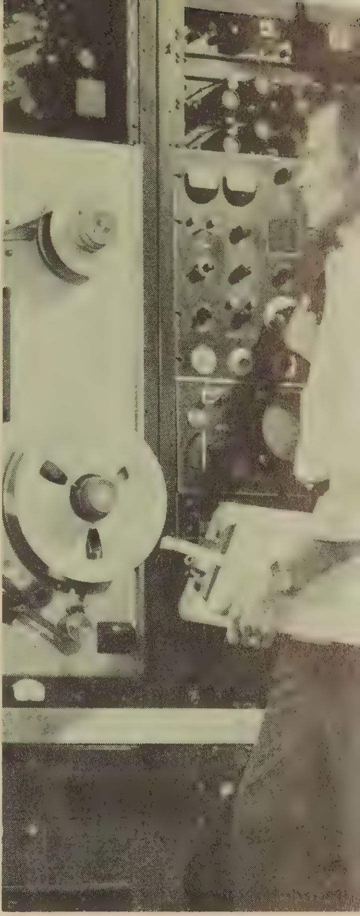
You get your hands on actual parts and use them to build, experiment, explore, discover. NRI pioneered and perfected the "home lab" technique of learning at home in spare time. Nothing is as effective as learning by doing. That's why NRI puts emphasis on equipment, and why it invites comparison with equipment offered by any other school. Begin now this exciting program of practical learning created by NRI's Research and Development Laboratories. It's the best way to understand the skills of the finest technicians—and make their techniques your own.



"BITE SIZE" LESSON TEXTS PROGRAM YOUR TRAINING

Certainly, lesson texts are necessary. NRI's programmed texts are as simple, direct and well illustrated as 50 years of teaching experience can make them. They are carefully programmed with NRI training kits to make the things you read about come alive. You'll experience all the excitement of original discovery.



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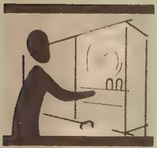

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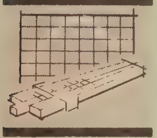

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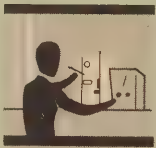

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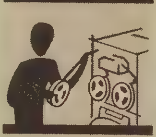

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Radio-Electronics
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DR. ELMER W. ENGSTROM
PRESIDENT, RADIO CORP.
OF AMERICA

Color TV—Today and Tomorrow

By DR. E. W. ENGSTROM

By the end of 1964, color television will have become a billion-dollar-a-year industry. What makes this figure unusual is that compatible color television service was authorized by the Federal Communications Commission only 11 years ago, on Dec. 17, 1953. That same evening, the first color program televised under the compatible standards was put on the air by the National Broadcasting Co.

By the end of 1954, about 7,000 color television sets were in use throughout the United States. Only five years ago, color TV was a $100-million-a-year industry, but by 1963 it had grown to $600 million. The year 1964 saw it surpass the $1 billion mark, with $750 million spent by consumers for new color TV sets, and the remaining $250 million going for service, studio equipment, production and other segments of the industry. And this is only the beginning.

Industry estimates are that approximately 3 million color sets were in use by the end of 1964. By the end of 1968, we anticipate a total of about 15 million sets. This represents a five-fold increase in 4 years, putting color's share of the total domestic television market at a 1-to-4 ratio.

But growth figures, impressive as they are, tell only part of the story. Color television is a marvel of research and engineering. It is the most complex consumer product on the market today, yet it is being mass-produced at a price within reach of the average consumer.

Looking ahead, we can already see color TV taking new forms. Ever since it was put on the market, the 21-inch, round, 70° color picture tube has been the standard for the industry. Now there is a move to rectangular shapes and RCA has such a tube in limited production. It appeared in some sets before the end of 1964. Other manufacturers also have announced plans to produce tubes of this size and shape. In addition, the 19-inch rectangular tube is expected to become commercially available in limited quantities during the second quarter of 1965.

The rectangular 25-inch 90° tube offers several significant advantages over the 21-inch round type. The most dramatic change is size. More than 4 inches have been trimmed from the tube's depth, making it possible to produce slimmer, better proportioned cabinets. The 25-inch tube also provides a larger viewing area—295 square inches in contrast to 261 on the 21-inch tube.

Behind these improvements lies a substantial engineering and design effort. The new family of tubes uses a new glass bulb which alone represents a $4 million investment. Completely new shadow masks and electron guns had to be designed and a radically new lens system developed. A new technique for applying phosphor dots to the screen has brought the added bonus of a brighter picture.

These basic changes have resulted in an attractive additional type of display device that will further speed the already rapid growth of the market for color television. This, in turn, will provide new jobs, new investments, new businesses and new revenue from a multitude of new commercial enterprises.

We have seen before how new industries add vitality to the economy. Radio did it in the 1930's and 1940's, and black-and-white TV in the 1950's. Color will have an even greater impact over the next decade when global color television will become commonplace.

From the laboratories, we can anticipate in the future more advanced display techniques with integrated circuitry that will further reduce the size of the set. Eventually, we can look forward to thin-screen receivers on the wall, designed in many sizes and surrounded by frames that contain all the needed circuitry.

These receivers of tomorrow will rely on program material from all over the world. Already, color television is in its fourth year of regular commercial service in Japan. In Canada, color receivers are in assembly-line production. In Europe, government authorities are seeking agreement on standards for color. Before long, audiences watching a single color program may number as many as a billion persons, receiving signals transmitted through satellite systems.

In the future, color television will serve us in new functions as well—in point-to-point communications, allowing individuals to hold private, two-way conversations and see each other in natural colors as they talk; in closed-circuit systems for industry and education, and in space systems for communication with astronauts and for the visual exploration of other planets.

Color television will thus play a role of mounting importance in the arts and sciences of communication, and will exert an increasingly profound influence on the entire radio and electronics industry. Its limits for service will be only those of the imagination. END

Dr. Engstrom is almost unique among executives—he rose to the presidency of RCA through the research and science, rather than the business branches of the company. In his 31 years of service with RCA, he has both contributed to and directed major research and engineering programs. Among other important activities, he headed the research program that resulted in the development of our present all-electronic color television system.

NEW TYPES ARE APPEARING AT LAST

By DAVID LACHENBRUCH

WHAT'S NEW IN COLOR TUBES?

AS COLOR TELEVISION SALES CONTINUE to swing upward, the stakes for new inventions are getting higher. And, existing methods and devices have become more refined—and more deeply entrenched. This is particularly true of the shadow-mask tube, which continues to be the "industry standard," despite many challenges.

The television industry expects to sell approximately 2,000,000 color sets in 1965, and the year should end with color in nearly 10% of America's television-equipped homes. Virtually every one of those color sets will have a shadow-mask tube.

With color TV about to enter its biggest year, what are the prospects for new picture tubes or other color display devices? Do practical alternatives to the shadow mask now exist? Are new devices or systems now on the horizon?

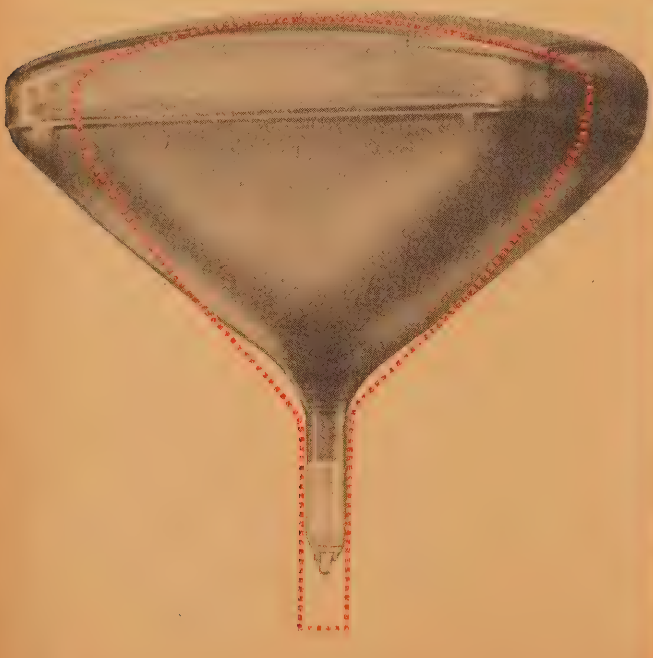
The shadow-mask tube, of course, will completely dominate 1965's production—but in several new forms. As 1965 closes, it's likely that the familiar 21-inch round color tube with 70° deflection will be nearing the end of its 10-year reign.

Five American manufacturers are now making color tubes for the original-equipment market—RCA, Zenith's subsidiary Rauland Corp., Sylvania, National Video Corp. and—on a very small scale—Philco's Lansdale Div. Admiral has started to construct a color-tube facility, but has stated that it won't be in production until 1966.

In mid-1964, Sylvania announced a new, brighter screen for the standard 21-inch 70° round shadow-mask tube. The claimed 43% increase in light output was attributed to the method of applying the screen ("dusting") and to a new red phosphor based on a rare-earth element, europium. This brighter tube is appearing in sets already on the market from several manufacturers, including Sylvania, Sears Roebuck (Silvertone) and Magnavox.

Earlier in the year, Motorola and National Video Corp. licked the production problems that had held up their 23-inch rectangular 90° shadow-mask tube. It is estimated that perhaps 100,000 of these 23-inch rectangular color tubes were produced in 1964, as compared with at least 1.5 million 21-inch round tubes.

Also in 1964, for the first time, a color set with a 16-inch rectangular tube showed up on the American market. This is a Sears Silvertone console, built to Sears' specifications by Tokyo Shibaura Electric Co. (Toshiba) in Japan. Listing at around $350, it carries the Underwriters Laboratories seal. Its picture tube is a 70° shadow-mask type. The 16-inch color tube apparently is destined to become the standard size for Japanese color, and a 90° version is being made in small quantities. Two other Japanese-made 16-inch color sets have been promised in this country—the Sharp (by Hayakawa) and the Delmonico (by Victor of Japan). An 11-inch shadow mask has been announced by Nippon Columbia, but no export plans have been outlined.



A rectangular 25-inch RCA color tube with the outline of the older 21-inch type superimposed on it. Difference in length is significant.

In this country, the big changeover to rectangular color tubes is just beginning. Most of the major tube producers have started to put out the new 25-inch rectangular tubes, and some high-priced 25-inch sets are now on the market. The various makes of 25-inch tubes are not directly interchangeable. RCA's version differs from those made by Zenith and Sylvania in focus voltage, heater current and neck length—the latter two brands being approximately ¼ inch longer than the RCA. The planned National Video version, if produced at all, will be markedly different electrically from the others. All of them use the same 25-inch "hard-glass" color bulb developed by Corning Glass Works.

According to specifications released by RCA, their new color tube has a screen area of 295 square inches, compared with 261 for the 21-inch round tube, and its front-to-back depth is a shade less than 21 inches, or 4⅓ inches shorter than the current standard tube. Its aspect ratio is 4 by 3.12, providing an increase in width compared with height. The new tube is considerably more expensive than the 21-inch round, and therefore the bulk of sets sold in 1965 are expected to use the older one.

With the 25-inch tube, RCA started a new method of applying the phosphor screen which is said to increase brightness substantially. A variation of RCA's "slurry" process (as opposed to Sylvania's "dusting" method), the new screening technique is being applied to both 21- and 25-inch tubes. Brightness of RCA's 25-inch tube will be further increased in the near future with rare-earth phosphors, possibly similar to those used by Sylvania.

Latest development was the announcement in October by RCA that 19-inch, 90-degree rectangular color TV tubes would be available in limited quantities during the second quarter of 1965. The new tubes are to be priced about $10 higher than the standard 21-inch 70° round color tube, according to John B. Farese of the RCA Television Picture Tube Division.

The dimensions are: minimum screen area 180 square inches; minimum height 12.138 inches; minimum width 15.542 inches, diagonal 18.012 inches and length 18.048 inches. It will thus be about 7 inches shorter than the 21-inch, 70° round color tube. The new tube will be designed to use the components (yoke-deflecting, purifying, and converging devices) that were developed for the RCA 25-inch tube.

Following the introduction of the 19-incher, a still smaller tube has been envisioned—possibly an American version of the 16-inch rectangular 90° one. This one could be ready late in 1965 or early in 1966.

Other tube types

The second most commonly discussed type of color tube is the *Lawrence*, which uses phosphor strips instead of dots, and a wire grid near the screen to direct electrons to the correct color strip. This tube, at least in theory, has the advantages of simple circuitry (in the single-gun version) and far greater brightness (in the three-gun version). Paramount Pictures holds basic patent rights to this tube, which it calls the Chromatron.

At press time, the only company holding a license to produce the Chromatron tube and associated receiver circuits is Sony of Japan, whose rights include both production abroad and in the United States. Sony has shown a prototype of a 19-inch single-gun Chromatron consolette, which it hopes to put on the Japanese market (for "less than $550") this spring—but there are no plans to export it to the United States before 1966.

Sony's single-gun tube gives a picture slightly larger than 17 inches diagonally. Its front-to-back depth is 17.3 inches. The screen is coated with vertical phosphor stripes,—twice as many red stripes as greens or blues, because of the lower efficiency of the red phosphor. Sony claims the tube has a brightness of 90 foot-lamberts peak white, or about 2½ times greater than the shadow-mask tvpe. The complete Sony color set weighs 103 lbs.

Several other Japanese companies are using various aspects of the Lawrence-tube approach. One of them is Yaou Electric Co., which has shown preproduction prototypes of a 9-inch all-transistor set. The color tube, made by Kobe Kogyo, is designed to work on a line-sequential principle—one line of red, one of green, one of blue and so on.

No American picture-tube manufacturer is known to be seriously considering the Lawrence tube at this time, but its appeal—particularly for small, low-priced sets—is such that it can't be ruled out, especially if the Sony color sets are successful. For example, General Electric conducted extensive research on the "post-acceleration" picture tube in the 1950's. G-E has not yet announced any plans for color-tube production.

The Sony tube compared with a conventional type and its convergence apparatus, not needed on the post-acceleration deflection type of tube.

Philco's Apple, or beam-indexing, tube and receiver widely publicized in the 1950's, then becoming dormant, was mentioned recently by Philco, after a long silence. In announcing plans for color-tube production, Vice President M. W. Newell, general manager of Lansdale, said that Philco's "revived [color] research efforts will build on [its] extensive Apple system development program for color television."

Color without color tubes

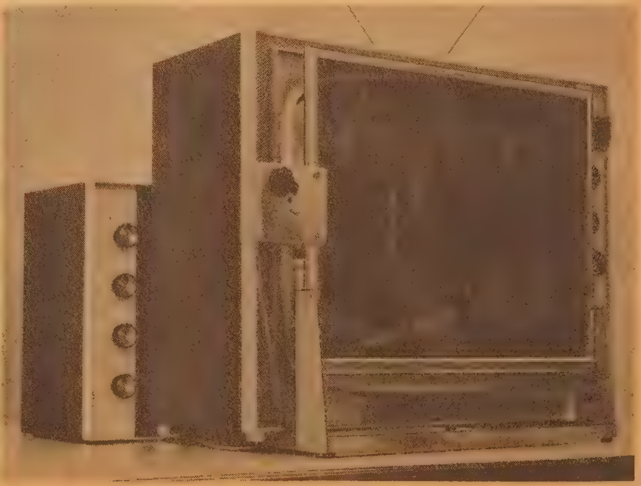
Two-color sets without color tubes showed up in the United States this year. One, by Mitsubishi of Japan, is a revival of an idea which predates the first color tube—the trinescope. The set uses three 6-inch tubes—one for each color—with dichroic mirrors to converge the images. Although it's called "color micro TV," the cabinet isn't very micro, considering the fact that the picture measures only 6 inches. The set, which looks at first glance like a large oscilloscope, is in a metal cabinet 20 inches high, 18½ inches deep, 13 inches wide and weighs 64 lb. It sells for $255 in Japan, and the manufacturer has shipped several to this country in exploration of export possibilities. (RCA, incidentally, used a similar system—but with 10-inch picture tubes—to demonstrate its color system to the FCC in 1949.)

Another system which gets color TV from black-and-white tubes is an ingenious electromechanical converter developed by Scope, Inc. of Falls Church, Va. It is now being produced by National Radio Institute.

To adapt a set, a small chassis is bolted to the rear of the receiver and six circuit connections made. A transparent 19-inch screen is positioned directly in front of the set by resting the set on the screen's adjustable legs. The converter chassis changes the color signal to a two-color field-sequential type.

The screen is composed of two layers, one with alternate vertical stripes of cyan and orange, the other with alternate transparent and black stripes. One portion of the screen vibrates laterally in sync with the field-sequential color signal; while the other remains stationary. NRI will market the converter for $109. After market-testing the converter, NRI hopes to license a major TV manufacturer to produce a complete small-screen two-color set using the same principle. This set would retail for less than $200.

The Scope converter. Equipment at rear left changes the signal to a two-color sequential type, and the vibrating color screen in the frame in front of the black-and-white tube supplies the color.



Another color conversion device has been in use for some years. Called Colordaptor, it was first described in RADIO-ELECTRONICS in January, 1956. From that date conversion kits have been sold in small numbers by the developers, Colordaptor, Menlo Park, Calif. It changes the signal to a sequential type like that of the old CBS system, and uses a color wheel ahead of the black-and-white tube.

Although many radically new color tubes and other display devices (including projection systems) have been proposed for the future, only one is known to be receiving serious consideration now. This is the thin color tube of Video Color Corp., Ingleside, Calif.

Video Color was established to wed the Kaiser-Aiken "thin tube" with the color-tube screening principles developed in the 1940's by C. Willard Geer, who is engineering vice president of the new firm. The company has been building lab samples of a two-color flat tube for military display uses, but it also holds an option to obtain a license from Kaiser Industries Corp. to manufacture, for the home TV field, the flat tube invented by Dr. William Ross Aiken.

This year, Video Color held informal demonstrations for at least one television set manufacturer. It showed one of its military tubes—a two-color unit, slightly more than 2 inches thick, about 11 inches in diagonal measurement. The consumer version would have a three-color screen, and presumably much greater brightness than the shadow-mask tube. If such a tube is developed for home use, it probably is at least 3 to 5 years in the future.

Any really new color display system for the home, no matter how valid, now suffers a built-in disadvantage because it will be bucking a going system. Tube manufacturers have spent hundreds of millions of dollars on development and machinery for the shadow-mask type. Its steady improvements have made it a moving target. Thus, an alternative approach which may have looked superior to the early shadow-mask tube may now suffer by comparison.

As the years go by without a serious alternative to the shadow mask, the present tube lengthens its lead over all potential competitors. As compared with early versions, the current shadow-mask tube is easily produced, far brighter, more precise, capable of extremely long life. Nearly 4,000,000 have already been built.

Some day, different types of color displays will be in common use. But for the near future, it's going to be extremely difficult to prove to the television industry that other designs are superior to the tried-and-proven shadow-mask—even with all of its acknowledged drawbacks. END

THINKING OF COLOR TV?

By MATTHEW MANDL

DESPITE THE RAPID GROWTH OF COLOR TV, many service technicians have yet to repair a color set. Some have kept more or less abreast of developments, but still hesitate to tackle such work. Color TV would get a big boost if independent service technicians were ready to recommend it to their black-and-white customers. But this will happen only when technicians develop enough confidence in their ability to install and maintain color receivers.

When you get a chance to recommend a particular receiver, tell the customer what to expect about initial costs, service rates and reception compared to black-and-white. You will be in a better position to speak with authority if you own a color set yourself. So, if you intend to buy a color receiver, or recommend one to a customer or friend, you will be interested in these things:

Why buy color now?

Ask almost any color set owner what he thinks of color TV and you'll get a highly enthusiastic opinion. Why, then, are color TV sales only a small percentage of b-and-w? It appears that some time will elapse before color set ownership reaches half the number of b-and-w. Retailers say that customer sales resistance usually includes these objections:

- Cost is too high
- Colors are not true
- b-and-w picture does not compare to that on a b-and-w set
- Set too complicated to operate

Let's take these in order and see if we can clear up some misunderstanding. First, cost. Curiously, with many prospective customers, it's not a question of *affording* a color set (what with time payments, higher incomes, etc.). They

Color TV will "go" only when each set is adjusted for top performance by a well-trained technician

simply think they are paying more than they should for TV. Here is one of several areas where technicians and retailer need to do some field work in acquainting prospective customers with facts. Certainly color sets are more costly. One big item is the color tube with its three guns, tricolor phosphors and other internal components. Also, color receivers need more circuitry, more factory adjustments and larger cabinetry. Yet, costs have come down recently. For comparable sets, there has been as much as a $100 drop below what color TV cost last year. This despite improvements and simplified controls in the newer receivers.

If prospective customers are waiting for color sets to sell for what b-and-w do, it will be a long time before they enjoy color. There is no indication that color set prices will eventually compare with b-and-w for the same tube size. If any radical breakthrough develops to lower color TV costs (modules, microminiaturization, etc.), b-and-w set costs will also come down, and there will still be a considerable cost difference between the two. It appears that prices may stabilize around $400 for some time. More elaborate receivers may cost over $500. Thus, it is a mistake to wait for prices to tumble before buying color. In the meantime some excellent color programming is being missed.

Color pictures, *in a properly adjusted set*, are excellent. Why, then, do many believe that color is not authentic, that the black-and-white pictures always have color fringing, that a particular color always predominates? The catch, of course, is in phrase at the beginning of this paragraph: a *properly adjusted set*.

Check this out yourself sometime. Visit the small dealer, the chain store, the discount house, and look at the various color models during a color telecast. Only a few places have the receivers properly adjusted. Excuses are varied: "We have so many sets on one antenna, we can't get good reception" or "We haven't had time to adjust these, but they are good sets." The stock phrase seems to be: "After we make delivery we adjust it properly."

Here, then, is a big stumbling block. Far too many dealers appear indifferent to how this affects color TV sales. Perhaps they depend too much on the inherent glamour of color alone. One salesman, when told that the wrong colors were on the screen said, "Sure, but aren't they pretty!"

What is needed is willingness to take time to put each receiver in proper working order and to have technicians upgrade themselves in competence so this can be done without too much trouble. Dealers must learn that color TV can't be uncrated and put on the showroom floor like b-and-w sets. With proper adjustments, color programming would more than double sales in short order.

Virtually all modern color sets are capable of excellent b-and-w reproduction. The black-and-white picture compares favorably with the better b-and-w sets—with a fairly wide contrast range. Don't expect the overbrilliance you see on some b-and-w sets; this type of picture is unnatural anyway. Picture highlights and background tone in a color TV may be better when receiving b-and-w than for some of the inexpensive b-and-w receivers because of the direct coupling between video amplifier and picture tube. Not all b-and-w sets have that.

As for color TV being too complicated to operate—this is just not so. Controls the viewer is concerned with have been reduced and simplified in the past few years. There are only two more controls than on the usual b-and-w receiver. The youngsters of many color set owners have no trouble getting a good color picture. As for the hidden controls—those should be adjusted only by the technician.

From the engineering standpoint, there is little to recommend to the customer about which set to buy. Most receivers use color circuitry proven effective for many years. Primary differences are in the demodulator sections. Some receivers (such as RCA and Admiral) use *low-level demodulation*. Here, the chroma signals must be amplified after demodulation to raise them to the level needed to drive the CRT grids.

Other receivers (such as Zenith) use *high-level* demodulation. Here, specially designed tubes are used, containing double anodes and balanced deflector plates. (The 6JH8 is a typical example.) This type of tube eliminates phase-inversion stages and extra color-amplifier tubes.

Motorola has used the compactron 15LE8 tube as a combined subcarrier oscillator and color demodulator. These systems all produce excellent color reproduction, and the differences are only matters of design practice.

The service technician's opinion is often sought about printed circuits vs hand-wired types. Printed circuits reduce the cost of the receiver because they simplify manufacturing. Repair bills may be higher, though, because of the extra time often required to service such circuits. Tracing the circuit and finding components are more time-consuming than on wired circuits, and this is, of course, usually reflected in the service charges.

Another article, to appear in an early issue, will bring you up to date on some recent improvements in color circuitry and servicing, and show you, as a technician, how you can advise customers and potential customers of those improvements. END

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The constant-voltage line is used in practically all big sound installations. It's also the easy way for smaller ones —if you know how to use it! Briggs of Wharfedale tells you how! . . . in February Radio-Electronics.

Secrets of Color TV Service

The service technician generally overlooks one important difference between color and B & W TV service—the customer! Yes, it's the same man—or woman. But the higher repair bills that go with color, plus the fact that the best alignment and convergence cannot produce perfection, make for a different attitude. Next month Art Margolis tells you how to deal with it.

FEBRUARY ISSUE
(on sale January 19)

ABC's of Color TV Service

Replace the gobbledegook with common sense and you'll be surprised how simple color service is

By ROBERT G. MIDDLETON

A BLACK-AND-WHITE TV RECEIVER MAY have 19 tubes—a color receiver may have 26. This does not mean that a color receiver is harder to service. Here's why. A black-and-white combo may have 28 tubes—but it is no harder to service than a 19-tube receiver. The technician tackles only the TV section, if there is no picture. He works on the phono section, if the Beatles won't sing. He investigates the AM section if the local broadcast station is silent. In other words, he resolves the job into a TV, radio or phono service problem. He disregards the TV and phono sections if symptoms show that the trouble is in the AM radio section. An AM radio is an AM radio whether it is alone or on a combo chassis.

A color TV receiver is just another type of combo. It is a black-and-white TV receiver with a color-circuit section. You can have a black-and-white picture with no sound. We know an FM radio is an FM radio, whether constructed on an FM radio chassis or inside a TV. Who's afraid of an FM radio? Everybody *would* be afraid if informed that "Values of Bessel functions here involved, of zero order, for integral values of the argument from 1 through 9, and for orders 1 through 44, corresponding to integral values of the argument 1 through 29, are as follows:"

The long-haired mathematician who polished that gem would probably be panic-stricken if you sat him down at a service bench. By the same token, the joker who runs off at the mouth about R − Y, B − Y, G − Y, colorimetry, product demodulation and readjusted chroma values is least likely to suceed at the service bench. The common-sense technician who looks at chroma circuits as he looks at FM-radio circuits has it made.

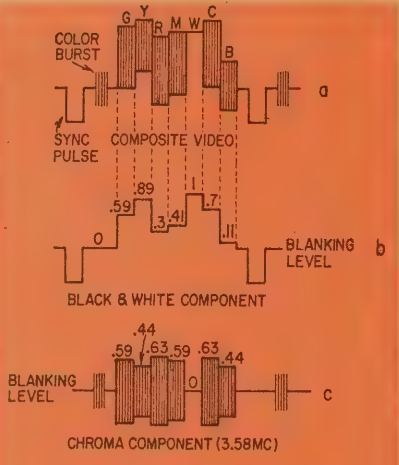


Fig. 2—How color signals compare with black-and-white. Complete signal is at a, black-and-white at b, and chroma at c.

Forget the gobbledegook

It has its purposes, but not at the bench. Let's get down to brass tacks. Fig. 1 is a common-sense block diagram of a color TV receiver. The sections to the left of the picture tube are those we find in an ordinary black-and-white receiver. The sections to the right are what makes a color receiver a combo. *These left-and-right sections can work independently of each other, and often do.* For example, if you tune to a black-and-white program, the right-hand sections are "killed" by an electronic switch, part of the chroma amplifier.

If a circuit defect stops the black-and-white signal in the video output stage, and you tune to a color program, you see a color picture with no black-and-white reproduction. Again, if the 3.58-mc oscillator is dead, and you tune to a color program, you see a black-and-white picture with no color reproduction. *A color receiver is a combo, and your troubleshooting approach can be profitably based on this viewpoint.*

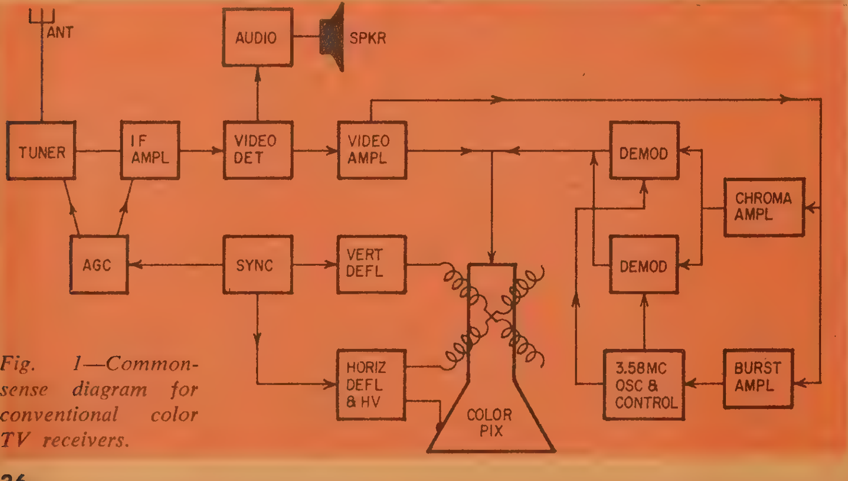


Fig. 1—Common-sense diagram for conventional color TV receivers.

Black-and-white vs color signals

The difference between a black-and-white and a color signal is shown in Fig. 2. The black-and-white signal is seen in B; the chroma signal in C. Add B and C and you get the complete or composite video signal A. This is the output from the video detector, when you apply a color-bar signal to the receiver. After the video detector, the complete color signal is separated into its black-and-white and chroma components. Both end up at the picture tube. The black-and-white signal is applied to the cathodes of the color picture tube; the chroma signal to the picture-tube grids.

Note that if the receiver is working properly, you will see a normal color-bar pattern on the screen. If the chroma signal is "killed" in the chroma amplifier, you will see gray bars (with no color). Again, if the signal is "killed" in the video amplifier, you will see dim color bars. This is a basic example of color picture analysis. Remember that if the chroma sections fails, the color TV receiver becomes the exact equivalent of a black-and-white set.

The signals are separated by tuned transformers and traps. Note that the chroma signal component (Fig. 2-c) has a frequency of 3.58 mc. When the complete color signal passes through the video amplifier, the 3.58 mc trap stops

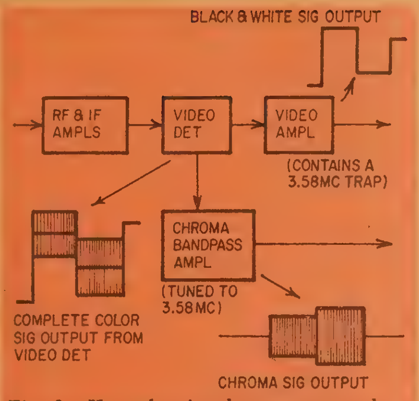


Fig. 3—How the signals are separated.

the chroma signal component, as in Fig. 3. On the other hand, the chroma amplifier is tuned for a bandpass response centered on 3.58 mc. Hence the black-and-white signal component is stopped, while the chroma signal passes through.

This separation depends on the fact that a black-and-white signal is built up chiefly from frequencies below 3.58 mc. A chroma signal is built up from frequencies in the vicinity of 3.58 mc. Typical frequency-response curves for the video amplifier and chroma amplifier are shown in Fig. 4. Clearly, the chroma amplifier must be in a good alignment. Misalignment causes weak color reproduction, distorted colors, interference in the color picture or no color. The chroma signal must be picked out at full strength, and must be effectively separated from the black-and-white signal. Then it can be broken down into its red, green and blue components.

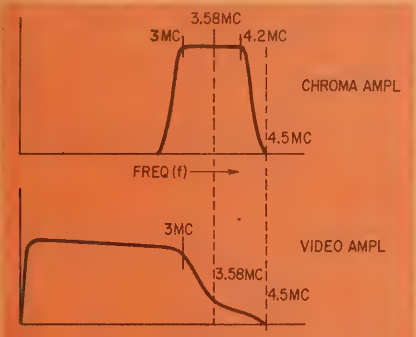


Fig. 4—How complete video signal and chroma component curves look.

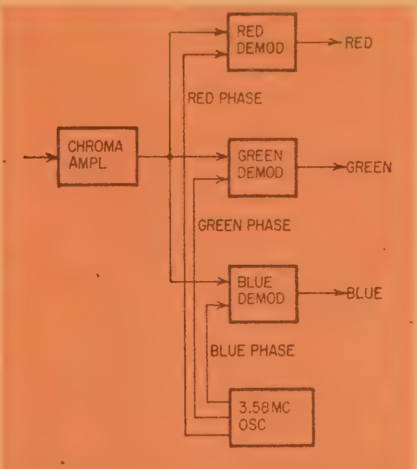


Fig. 5—One way to detect the color signals is to use three demodulators.

Breaking down the chroma signal

When all three cathodes of a color picture tube are driven by the black-and-white video signal, a black-and-white picture is displayed. We also know that when the red grid is driven, red appears on the screen; when the green grid is driven, green is displayed; when the blue grid is driven, the color is blue. It follows that the chroma signal must be broken down into its red, green and blue signal components.

The simplest way to do this is to use three chroma demodulators (Fig. 5). This method is used in the Japanese Toshiba receiver. The demodulators are detectors, and each is like the phase detector in a horizontal afc circuit. We can say that each of the demodulators in Fig. 5 is locked in on a different chroma phase. Each demodulator picks out the signal phase to which it is locked. It rejects the other two phases.

Stripped of all gobbledegook, the chroma signal is a three-phase signal, as shown in Fig. 6. All three signals have the same frequency (3.58 mc), but they are separated in time. The three chroma demodulators in Fig. 5 are operated essentially as electronic switches. Each is driven into conduction at the peak of one signal in Fig. 6. This is done as shown in Fig. 5. The 3.58-mc subcarrier oscillator in the receiver supplies a different signal phase to each demodulator. In turn, each demodulator is driven into conduction at the required time.

Chroma demodulator lock-in

It is clear from Figs. 5 and 6 that the chroma demodulators must be accurately locked in (synchronized) with the transmitted three-phase signal. Otherwise the receiver loses color sync. Fig. 7 shows how a color-bar pattern breaks up into rainbows when the 3.58-mc oscillator is not locked. We know how the horizontal sync pulse maintains horizontal sync. In the same way, the color burst (Fig. 8) maintains color sync. Just as the horizontal afc phase detector holds the horizontal oscillator in sync, so the color afc phase detector holds the subcarrier oscillator in sync.

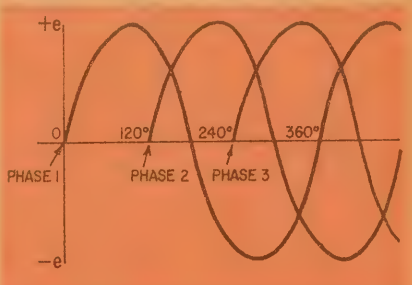
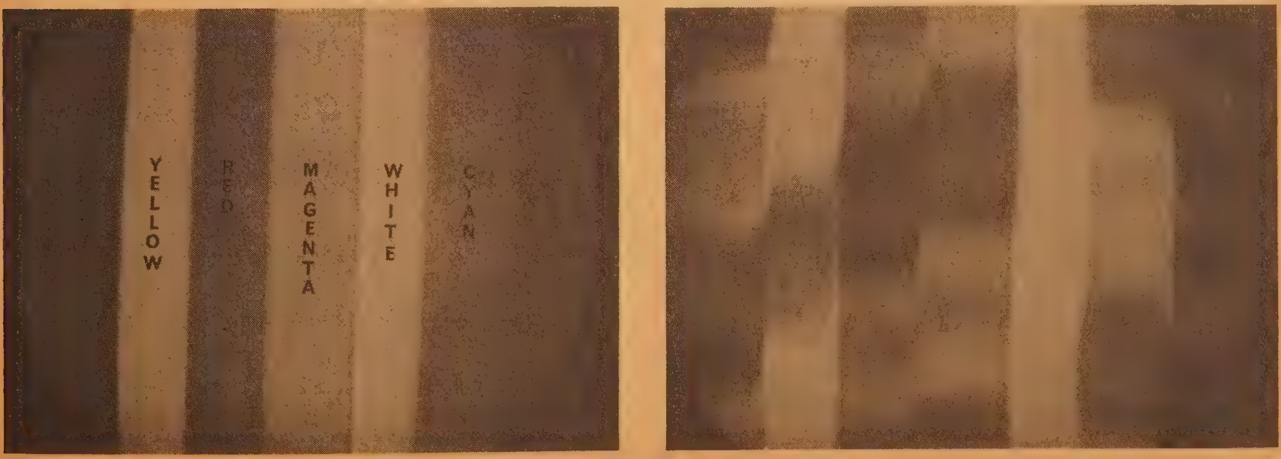


Fig. 6—Basic three-phase color waveform.

The burst amplifier is keyed into conduction in step with the color burst, so that a clean reference signal is fed to the burst phase detectors. A dc bias output from the phase detectors is generated by comparing the burst phase with

Fig. 7—Representation in grays of color-bar pattern in and out of sync.



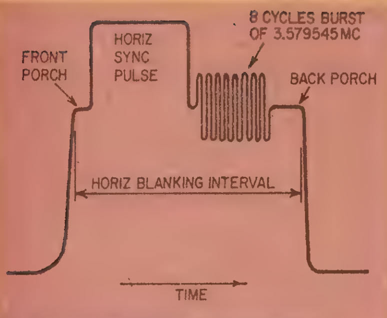


Fig. 8—Color-burst phase reference.

the 3.58-mc oscillator phase. This control bias is fed to the oscillator control stage to correct the oscillator phase as required. Hence, the chroma demodulators conduct only at the peaks of the chroma signals (Fig. 5).

Matrixing the signals

American color TV receivers do not use three chroma demodulators as in Fig. 5. Instead, they have two demodulators and a matrix to simplify circuitry. One popular arrangement matrixes the red and blue demodulator outputs to produce a green output signal (Fig. 9). How is this possible? Note in Fig. 6 that the red, green and blue chroma signals are 120° out of phase. This means that the green signal has red and blue signal components. In turn, the green signal can be obtained by mixing suitable proportions of the outputs from the red and blue demodulators.

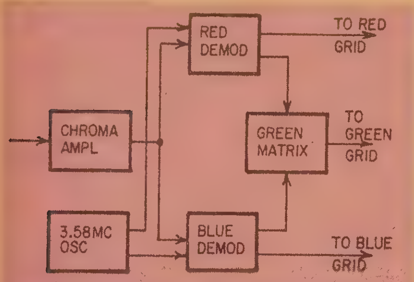


Fig. 9—How two signals make a third.

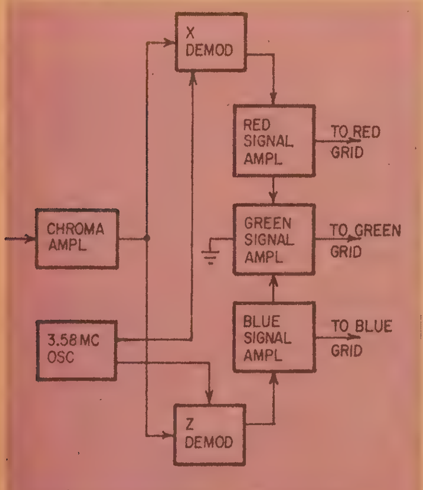


Fig. 10—X—Z matrix demodulation.

Another popular matrixing arrangement is shown in Fig. 10. The "red" demodulator is called an X demodulator by custom; likewise, the "blue" demodulator is called a Z demodulator. (We sometimes refer to the X and Z demodulators as red and blue demodulators.) Actually, the output from the X demodulator is not applied directly to the red grid of the picture tube; instead, it is modified somewhat in passage through the red amplifier. Similarly, the output from the Z demodulator is not applied directly to the blue grid of the picture tube; it is modified in passage through the blue amplifier.

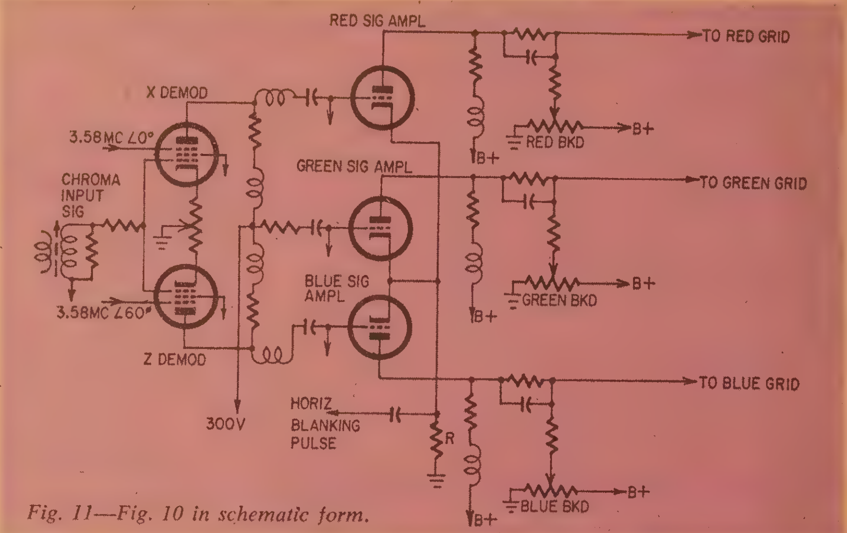


Fig. 11—Fig. 10 in schematic form.

The green signal is obtained by matrixing the red and blue amplifier signals. This is done by having a common-cathode circuit for the red, green and blue amplifiers (Fig. 11). Note that the common-cathode resistor R, not only provides a matrixed input signal to the cathode of the green-signal amplifier, but also produces interaction between the red-signal and blue-signal amplifiers. This is the reason why the output from the X and Z demodulators are not the same as the output from the red-signal and the blue-signal amplifiers.

The common denominator

A comparison of Figs. 5, 9 and 10 reveals that all chroma demodulator and demodulator-matrix systems have one feature in common—their signal outputs are fed to the red, green and blue guns of the color picture tube. This fact is of basic importance to the TV technician. It means that one fundamental test method can be used to check any demodulator system for correct operation or adjustment. A signal that produces maximum drive to the red grid normally produces zero drive to the blue grid.

Demodulator test signals are provided by color-bar generators. Let's consider the keyed-rainbow generator, one of the most popular instruments. A keyed-rainbow signal normally provides the pattern of Fig. 12 on the screen of the color picture tube. When there is trouble in the chroma-demodulation or matrix system, colors are incorrect. Although troubleshooting can be guided by the color pattern, circuit action can be evaluated better by scope waveforms.

The key troubleshooting waveforms are given in Fig. 13. Connect a scope and low-capacitance probe to the red-grid terminal of the picture tube. Adjust the receiver's color-phasing control to null bar 6, as shown. Then, transfer the scope probe to the blue-grid terminal; bars 3 and 9 should null. Finally, connect the scope probe to the green-grid terminal; bars 1 and 7 should null. If one of the waveforms does not null correctly, it will guide you to the defective circuit section. It can happen that two of the waveforms may not null, due to a defective component in a common branch of two circuits.

Note also that the relative amplitudes of the three waveforms in Fig. 13

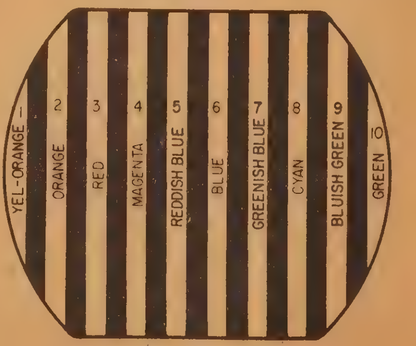


Fig. 12—Normal keyed-rainbow pattern.

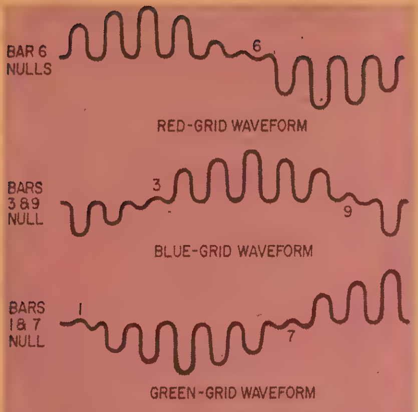


Fig. 13—Operating waveforms common to all chroma demodulation systems.

guide the technician to defective components in the chroma-demodulator or matrix circuitry. Relative amplitudes may vary from one receiver to another, depending upon the color picture tube used. Hence, check the receiver service data. Fig. 14 shows the relative amplitudes and permissible tolerances for a typical set. If either the blue or green waveform is more than about 10% out of tolerance, you must check the associated circuit for a defective component.

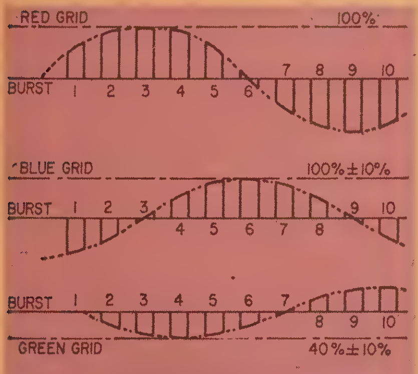


Fig. 14——Waveform amplitudes and tolerances for typical color receiver.

In conclusion

Color TV servicing is easy when we forget about the long-haired gobbledegook and approach service problems on a common-sense basis. Color receivers are just another kind of combo. After all is said and done, every circuit boils down to resistors, capacitors, coils and tubes. We need a color-bar generator and wide-band scope to check the chroma section, but a color-bar generator is easier to use than an AM signal generator—we do not have to tune a color-bar generator. A wide-band scope operates just like a narrow-band one. The difficulties of color TV servicing have been trumped up by the gobbledegookers—they are mostly imaginary. Let's get back to plain old common sense. END

Glossary of Color Terms

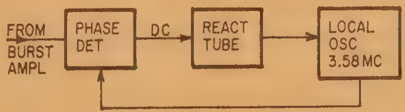
By ED BUKSTEIN

acc: Automatic color control (also automatic chrominance control). Similar to automatic gain control, except that it acts on the chrominance signal, automatically reducing the gain of the chrominance amplifier to prevent overloading on strong signals. The burst signal is rectified and applied as bias to the chrominance amplifier. An increase of burst amplitude will therefore decrease amplifier gains.

additive primaries: Primary colors are those which can be mixed to form other colors, but which cannot themselves be produced by mixing other primaries. Red, green and blue are the primaries in TV because, when added in various proportions, they produce a wide range of other colors. For this reason, red, green and blue are called *additive* primaries.

afc: Automatic frequency control. Two forms of afc are used in TV receivers: one locks the frequency of the horizontal scanning oscillator and the other maintains correct phase and frequency of the 3.58-mc local oscillator of a color receiver (see **apc).**

apc: automatic phase control. Because the 3.58-mc chrominance subcarrier is suppressed at the transmitter (only the sidebands are retained), it must be reinserted at the receiver. The receiver therefore contains a 3.58-mc oscillator. The reinserted carrier must be maintained at correct phase and frequency for accurate reproduction of the colors in the televised scene. For this reason, a sample of the suppressed subcarrier is transmitted (the color burst signal) and used in the receiver to control the local 3.58-mc oscillator. The general technique is illustrated below. A phase detector compares the burst signal to the signal from the local 3.58-mc oscillator. Any difference produces a dc output which controls a reactance tube which, in turn, controls the phase and frequency of the oscillator.



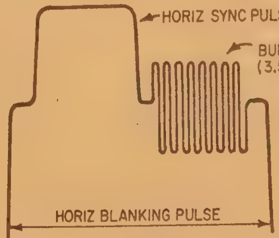
aperture plate: A thin metal plate mounted slightly behind the phosphor-dot screen of a three-gun picture tube. The aperture plate has many small openings so positioned that one of the three electron guns will excite only red phosphor dots, another electron beam will strike only green dots, and the third strikes only blue. The aperture plate is also known as an aperture mask or a shadow mask.

bandpass amplifier: The amplifier tuned for the 3.58-mc chrominance signal. Bandwidth of this amplifier is great enough to include the I and Q sidebands which carry the color information. This amplifier receives the total video signal but passes only the chrominance portion. The bandpass amplifier is also known as the chrominance amplifier or color amplifier.

blue gun: The electron gun whose beam, when properly adjusted, strikes only the blue phosphor dots in the color picture tube.

blue video voltage: The signal voltage that controls the grid of the blue gun in a three-gun picture tube. This signal is a reproduction of the blue output signal of the color TV camera.

brightness signal: Signal voltage that represents the variations of brightness in the televised scene. This signal is formed at the transmitter by combining portions of the outputs of the red (30%), blue (11%) and green (59%) cameras. The brightness signal is also known as the luminance, monochrome or Y-signal.



burst: A 3.579545-mc (roughly 3.58) signal transmitted for several microseconds after each horizontal sync pulse. In the receiver, the burst signal synchronizes the phase and frequency of an oscillator that reinserts the suppressed carrier. As shown above, the burst signal is carried on the back porch following the sync pulse.

B – Y signal: A color-difference signal representing the difference between the brightness signal (Y) and the output of the blue camera. In the receiver, the brightness signal is added to the B – Y signal to produce $B - Y + Y = B$. This B signal controls the blue gun of the picture tube.

to be continued

Color Television Throughout the World

Have other countries had experience with color TV? What are their problems? The editor of France's Electronique Industrielle **and** Toute l'Electronique **gives his views.**

By E. AISBERG

ELEVEN YEARS AGO, ON JAN. 2, 1954, the Federal Communications Commission gave the signal for television in color in the United States by authorizing color TV transmission by the NTSC (National Television Systems Committee) system. Progress has been slow, for there were few color programs and receivers were extremely expensive. Only since 1960 has the situation improved greatly. More than 300,000 color TV sets were sold in 1961, over 750,000 in 1963, and the figure for 1964 will certainly be greater than a million.

So much for the United States; what about the rest of the world? In one country—Japan—color TV seems to be doing as well as in the United States. Having adopted the NTSC system, that country commenced color television transmission in September 1960. Now 54 of the 284 transmitters of the Japanese television system (NHK) transmit color programs. The general network produces 22 color programs a week, a total of 9 hours and 30 minutes, and the educational network, 8 programs totaling 3 hours per week. It is estimated that by 1965 color networks will be completed and that 25 hours per week will be devoted to color programs.

The European problem

And where is color television in Europe? The situation here is infinitely more complex. Except for more or less sporadic experimental transmissions in England, France, Germany, Holland and the Soviet Union, there is *no* color television in Europe.

What particularly complicates things is that there is no single black-and-white television standard for all Europe. We have the CCIR standard of 625 lines and 25 images per second with negative modulation. This corresponds roughly to the American 525-line standard but is related to the European 50-cycle line frequency ($625 \times 25 = 15{,}625$ in Europe and $525 \times 30 = 15{,}750$ in the USA).

In France there are two standards: 819 lines and 625 lines, with positive modulation. England retains its ancient standard of 405 lines and has a new network with 625 lines. There are also differences in the passband, in the way the sound is transmitted (in some cases by frequency modulation, sometimes amplitude modulation) and the modulation of the video signal can be negative or positive, etc.

Under these conditions the choice of a standard—or more generally of a system—of color television is more complicated. It must above all present a double compatibility with black-and-white television: existing black-and-white receivers must be able to receive (in black-and-white, of course) programs transmitted by color stations. And receivers constructed for color must also be able to receive programs from black-and-white transmitters.

To complicate the situation still further, three systems of color television are proposed: the American NTSC system, the French SECAM system and more recently the German PAL. One can see how difficult is the task of CCIR, the International Consultative Committee on Telecommunications, which since 1958 has been studying the problem of color television to decide on a system.

At a meeting in Los Angeles in 1959 the committee decided to adopt a value for the color subcarrier (4.43 mc) and to allot color television channels of a uniform width in the uhf range. In the presence of several competing systems, UER (European Radio Union) formed a study group that cooperated in an exchange of information with the OIRT (International Organization of Radio & Television, which grouped the USSR and its satellites). In October 1963 this study group met in Rome, and in December in Zurich, to discuss color TV and prepare a report.

In February, a special session of the television committee of CCIR met in London to formulate a recommendation for choosing a system. This committee decided *not* to decide! . . . A new meeting will take place this spring in Vienna. If, as is hoped, a definite decision is then made, color television still cannot be expected to get under way in Europe before 1967.

The Radio & Television International Exhibition in Paris in 1967 and the Berlin Exhibition are likely to be held "under the sign of color television." Meanwhile let's examine the principles, advantages and inconveniences of each of the systems.

The fundamental principles

The three systems are obviously based on common principles. We know that, for the details of a color image, our eyes depend much more on difference in *brightness* than on nuances in colors. You can see that principle if you look at a child's coloring book. The color areas are very large and it matters very little if the child doesn't stay exactly inside the lines. What counts above all is the *design*, printed in black. As a result, the larger part of the channel passband is reserved for *luminance* transmission—that is, for the relative values of luminosity (brightness) of the different points of the image, or, if you prefer, of the black-and-white design. The different colors (the *chrominance*) are transmitted on a relatively narrow band of frequencies. In the three present systems, chrominance is transmitted on a subcarrier approximately 4.43 mc from the high-frequency carrier.

The color signal is generated by three cameras which take pictures through red, blue and green filters. We now have three signals that can be denoted by the letters R, B and G. Adding these three signals in proportions that correspond to the relative sensitivity of the human eye to the three colors (about 60% green, 30% red and 10% blue), we obtain the *brightness signal*: $Y = R + B + G$.

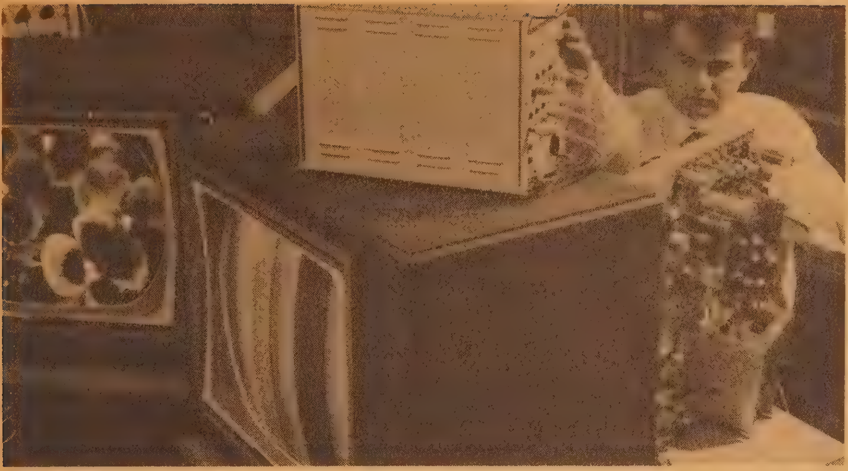
The subcarrier is modulated by only two signals, representing the difference between the red and the luminance signals ($R - Y$) and the difference between the blue and luminance signals ($B - Y$).

When a color program is received by a black-and-white set, it receives only the luminance signal, which is enough to re-create a full black-and-white picture. A color televisor receives the luminance Y and the two chrominance signals that modulate the subcarrier. To obtain the red signal, the chrominance and luminance signals are added in the receiver: $Y + (R - Y) = R$. The blue signal is obtained by adding $Y + (B - Y) = B$.

But how do we get the green signal? Very simply, by subtracting the sum of the two chrominance signals ($R + B$) from the luminance or Y signal ($R + B + G$):

$$(R + B + G) - (R + B) = G.$$

We need to modulate the subcarrier with only two "colors" to reproduce all



A French technician adjusts a color receiver (designed around SECAM principles) with the help of a seven-bar color pattern.

three—red, green and blue—at the receiver.

Differences between the three systems

All this is common to the three competing television systems. *The fundamental difference between them is in the way the subcarrier is modulated by the two chrominance signals.*

In the NTSC system, it is modulated in phase and in amplitude at the same time. The phase determines the *hue*. For example, at zero phase (the reference angle) you see purple, at 103° red, at 140° orange, at 167° yellow, at 241° green and at 270° blue-green. At 347° we have blue-violet.

Amplitude controls the color *saturation* (intensity). In other words, we can have a greater or lesser density for any color. Imagine a band of paper, one end of which is deep red and the other white, with a continuous transition so that we pass through all the shades of red, becoming lighter and lighter as we pass through the pinks, then going on to white. The red end corresponds to a saturation of 100%, the white end to zero saturation.

If we illuminate the paper band with a match, the *brightness* is weak, but that doesn't prevent it from having 100% *saturation* at one end and zero at the other. If we look at the same band with an electric light, or even by sunlight, the brightness is far greater but the saturation is the same for any point along the band. This saturation, in the NTSC system, is expressed by the amplitude of the subcarrier.

In the SECAM system (Séquentiel à Mémoire), invented by Henri de France and developed in the laboratories of the Campagnie Francaise de Télévision, the subcarrier is *frequency-modulated by one chrominance signal at a time*. For one line it is modulated by the (R — Y) signal, for the next by the (B — Y) signal, then again by the (R — Y) and so on. Thus the subcarrier transmits one or the other of the chrominance signals *alternately*. To recombine the two signals, they are placed in reserve in a *delay line* which holds them during the time it takes to sweep one line—54 μsec. At the instant when the (R — Y) signal is received, the delay line supplies the (B — Y) signal which arrived before. By the same addition and subtraction we saw just before, we win back the luminance and green signals.

Let us finally examine the PAL system, invented by Walter Bruch of the German Telefunken company. PAL in English stands for *Phase Alternative Line*. This system is a sort of combination of NTSC and SECAM. The subcarrier is modulated in phase and amplitude, as in the NTSC system, and the color signals (R — Y) and (B — Y) are transmitted alternately as in the SECAM system, but 180° out of phase. As in the SECAM system, the signal transmitted as the first line is held in reserve, and recombined with the signal that arrives in the following line, after having its phase reversed.

We might also mention another very recent "outsider", a system called ART, conceived by engineer Dr. Mayer of the Munich Institute of Radio-Technical Research. It is a sort of improvement on the NTSC system, with phase distortion reduced by introducing a reference signal that persists through the active part of each line. Unfortunately, this system suffers the grave defect of not being entirely compatible, in that it does not produce as good a picture on black-and-white receivers as do its competitors. Further, it shares with the NTSC system the defect of being difficult to record on magnetic tape. So it appears that ART is not likely to be considered in competition with the other systems.

Now that we have examined the known characteristics and peculiarities of each of these three systems, let us see why Europeans have not adopted the NTSC system, which has been thoroughly proved during the 11 years it has been in use. One disadvantage of the NTSC system is that it is difficult to record on video tape recorders of the Ampex type. This is a great inconvenience in a period when more and more television tends to be "canned".

What is even more serious is the extreme sensitivity of the NTSC system to phase distortion. At each step in its progress, as much between the studios and the transmitter as between the receiving antenna and the picture tube, the common signals risk having their phases modified. And each modification of phase manifests itself as a change in color. (That is why some evil tongues suggest that NTSC means "Not The Same Color.")

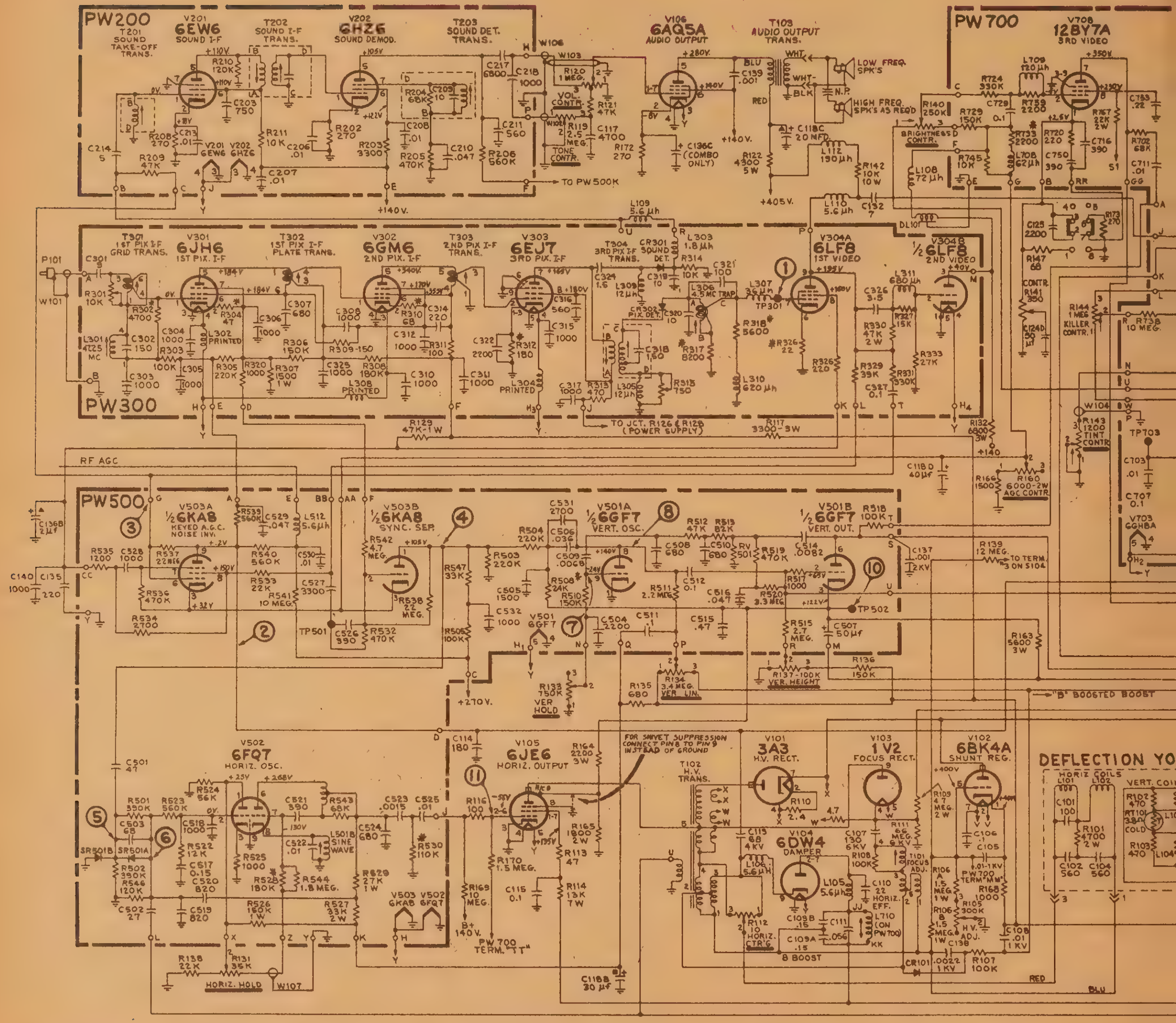
To remedy these phase distortions, NTSC receivers have a control to regulate color. But this leaves it up to the user to find the exact hue. He can modify the colors considerably in an *arbitrary* way and this is certainly not a good thing. The PAL and SECAM systems are free from such faults, and this constitutes a great advantage.

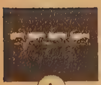
In tests carried on by the research departments of the Radiodiffusion Télévision Française, comparisons have been made between transmissions, over short and long ranges, with the three systems. It has been determined that *under good conditions*, when all controls are set correctly, the image is perfect in all three systems. But when conditions are less favorable, for example in a long-distance transmission with several relays and many disturbances, SECAM and PAL are definitely less subject to distortion than NTSC. Also, there is no need of a "hue control" in PAL or SECAM receivers. These sets are as simple to operate as black-and-white receivers.

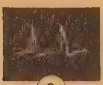
Their price is only a few percent above the price of black-and-white receivers. In fact, the thing that had been relatively expensive until recently—the delay line—is now being made of glass, which permits a considerable cost reduction.

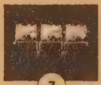
It is impossible to say now which will finallv be the system adopted for Europe. Technical considerations are possibly not the only ones that will be considered in the final choice. Questions of national dignity (or perhaps national vanity) will inevitably enter into the problem. Hopefully, Europe will finally stop acting like the donkey between two haystacks and permit itself to enjoy the incomparable improvement that can be offered by introducing color into television. END

Schematic Diagram RCA CTC16




15 V. P-P
①


750 V. P-P
②


25 V. P-P
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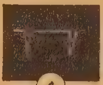
60 V. P-P
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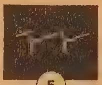
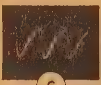
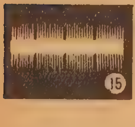

20V. P-P
⑤


36 V. P-P
⑥

⑦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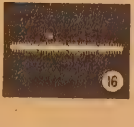
V701 PIN 6
40V. P-P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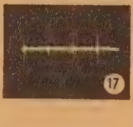
V701 PIN 2
4V. P-P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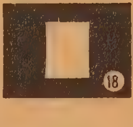
V705 PIN 3
100 V. P-P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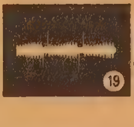
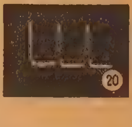
V705 PIN 2
15 V. P-P

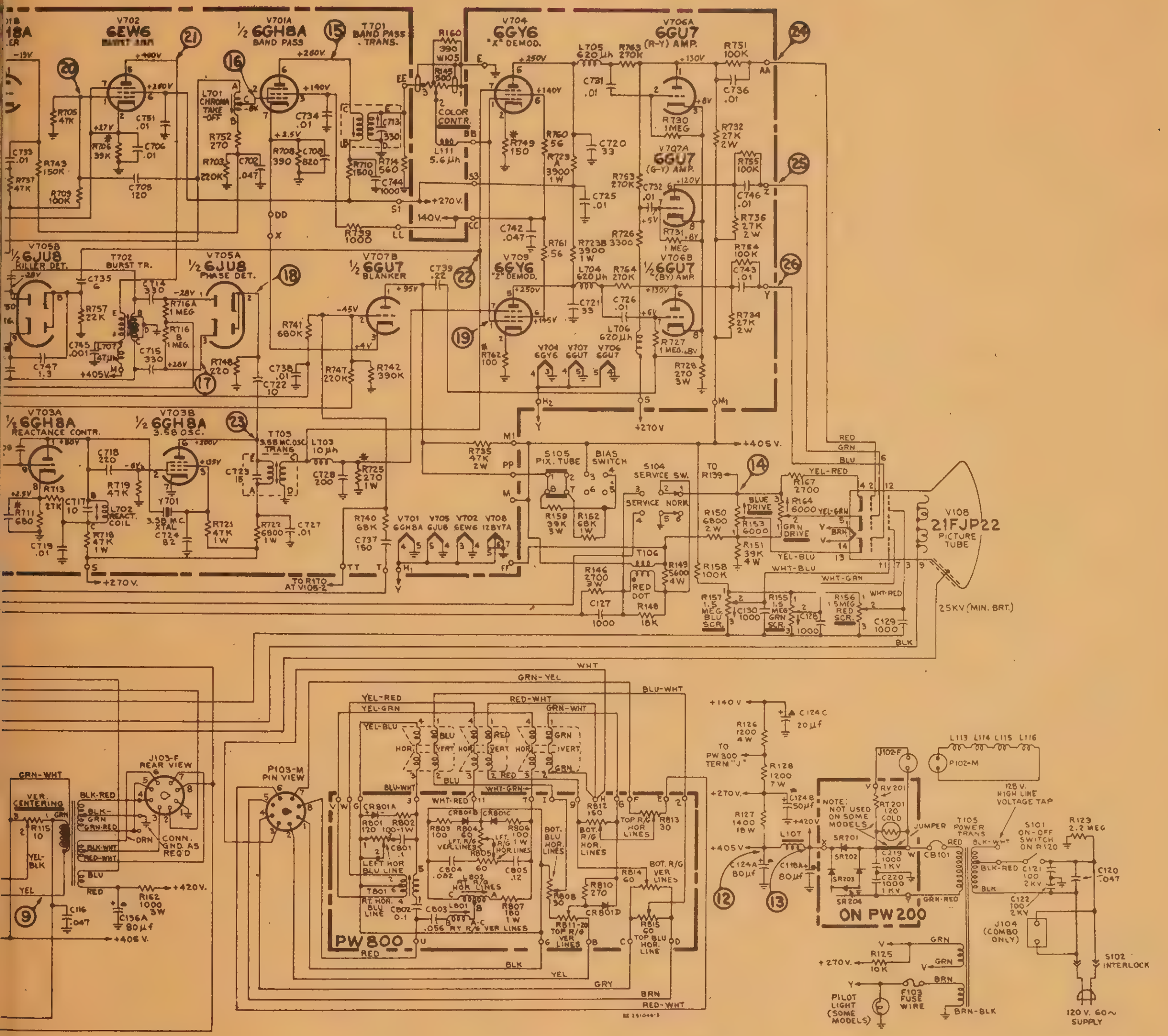

⑲
V709 PIN 1
0-20 V. P-P SET AT 5V. P-P WITH R145


⑳
V7
PI
65

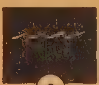
To date, nearly all color TV sets sold each year by manufacturers other than RCA and Zenith have been duplicates or close copies of a couple of the most recent RCA color chassis. Although most manufacturers will be designing and building their own chassis from now on, we expect that the RCA CTC 16 shown here will be the source of many of the circuits that will become standardized in color chassis of the next few years. We plan to run full schematics of the most interesting new models as they become available.

The CTC 16 is very similar to the 1964 CTC 15 and it takes a close look at the schematic to spot the subtle differences. Changes that technicians are likely to spot first are in and around the high-voltage cage. The

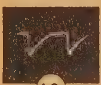
Color Television Chassis



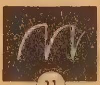
186 V. P-P



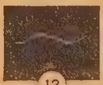
⑨ 100V. P-P



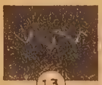
⑩ 12 V. P-P



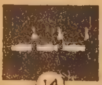
⑪ 210 V. P-P



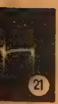
⑫ 3V P-P



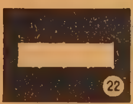
⑬ 30V. P-P



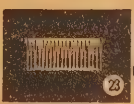
⑭ 100 V. P-P



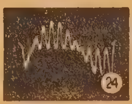
㉑ V702 PIN 5 200 V. P-P



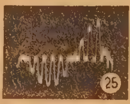
㉒ V709 PIN 7 25V. P-P



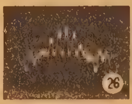
㉓ V703 PIN 6 100V. P-P



㉔ PW 700 TERM.(AA) 140 V. P-P



㉕ PW 700 TERM.(Z) 50 V. P-P



㉖ PW 700 TERM. (Y) 160 V. P-P

focus and horizontal centering controls have been moved from the high-voltage cage and relocated on the rear of the chassis next to the CRT screen controls. The tube projecting from the side of the cage is the 1V2 focus rectifier, brought back after having been replaced by a high-voltage selenium rectifier in last year's CTC 15.

Other changes are in the low-voltage power supply and on PW200, the printed-circuit sound board. The 6AQ5 audio output tube has been moved from PW200 to the chassis to make room for the four diodes in the new full-wave bridge power supply. The tuners (schematics not shown) are KRK118 for vhf and uhf i.f. and KRK120 for channels 14–83.

Roundup of 1965 Color Sets

A complete directory (at time of writing) of the new color television receivers

By ROBERT F. SCOTT

TECHNICAL EDITOR

THE MOST NOTICEABLE THING ABOUT the 1965 color sets is the vast increase in the number of models on the market. They are being sold by nearly all major manufacturers and under many private-brand labels. Outstanding differences in circuitry are few. All but the Zenith use X and Z demodulators with B — Y, R — Y and G — Y matrix amplifiers.

Nearly all are based on RCA circuits. Some are exact duplicates of the CTC 15 chassis. Others use RCA color circuits with minor changes in i.f. and audio circuits. A few use basic RCA circuitry and tube lineup with completely different chassis layouts.

Many manufacturers have mounted the dynamic convergence board where it is more accessible from the front of the set. Most models feature some form of automatic degaussing and nearly all will include it in late production runs.

Original service literature on 1965 color sets indicates that all except Motorola are using 21-inch, 70° round picture tubes exclusively. However, RCA has announced that they will be using the 25-inch, 90° rectangular tube in some models and that these tubes are available to other manufacturers. Thus we can expect to find rectangular tubes in wide use by the end of the year.

ADMIRAL D11, 1D11, 2D11, 3D11 and 4D11 chassis are used in the Admiral 1965 color receivers. They are 26-tube models. Four of the models have a distinctive tilt-out control center on the top right corner of the front panel. Tilting the control panel forward exposes the channel selectors and fine-tuning, volume, contrast, brightness, tint, color fidelity and video peaking controls. When the panel is tipped back, only the illuminated channel indicators are visible.

Circuit features include automatic degaussing (Admiral calls it amf—*a*utomatic *m*agnetic-*f*ree circuitry), a color fidelity control, automatic color intensity circuit and adjustable video peaking.

The automatic color fidelity control (Fig. 1) permits the viewer to adjust the warmth or coolness of color and black-and-white pictures to suit his taste. Black-and-white pictures can be viewed in tones ranging from cool blue to warm sepia. It minimizes the need for color adjustments whenever the TV set is moved or whenever the color purity is affected by stray magnetic fields.

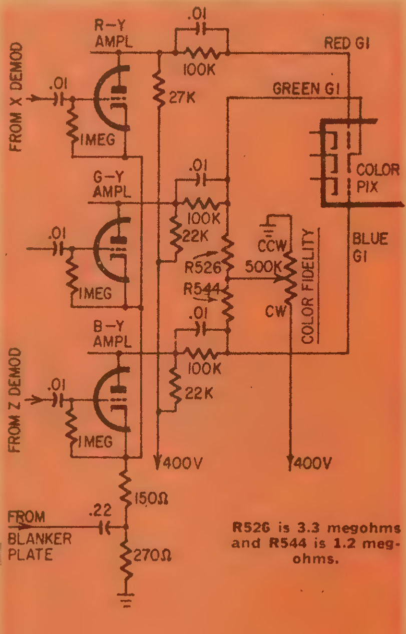
When the COLOR FIDELITY control is in the maximum counterclockwise position, the junction of R544 and R526 is grounded. These two resistors are proportioned so the blue grid voltage is about 8% below the green grid. Both these grids are at a lower voltage than the red, and the picture has a sepia tone.

When the control is turned fully clockwise, it places 400 volts on the junction of R544 and R526. The blue grid has less resistance (1.2 megohms) than the green (3.3 megohms), so its voltage is about 5% higher. The red grid is about 30 volts lower so the picture is predominantly blue.

The automatic color intensity circuit is shown in Fig. 2. (Several manufacturers use versions of this circuit and call it automatic chroma control or acc.) Its purpose is to adjust the gain of the bandpass circuit to keep the chroma and burst signals at relatively constant levels.

The negative control voltage used for the color killer is applied to the grid of the first bandpass amplifier. This voltage depends on the amplitude of the burst signal but is always high enough to cut off the color killer when a burst is present.

If the burst is weak, the negative biasing voltage applied to the bandpass amplifier is low, allowing the color signal to be amplified more. If the burst is strong, the negative voltage is higher and the amplifier's gain is reduced. This circuit is a special agc that automatically holds the color signal at a constant level in the bandpass and burst amplifiers.



R526 is 3.3 megohms and R544 is 1.2 megohms.

Fig. 1—Automatic color fidelity control used in Admiral receivers.

AIRLINE (Montgomery Ward) Models GST-8345A, GST-8355A, GST-8375A and GST-8385A use chassis apparently identical to Magnavox series 45 and Westinghouse V-2476-1.

Chassis 13-122-14U, 13-126-24U, 13-136-64U, 13-136-74U and model WG-8155A are identical to CTC 15.

ANDREA VCU-321 chassis very similar to CTC 11 chassis.

VCV-321 chassis similar to CTC 15.

BRADFORD (W. T. Grant Co.) Chassis series WGEC C40 and WGEC C40U are similar in circuitry and chassis layout to the CTC 12. Chassis WGEC C600 identical to CTC 15.

CLAIRTONE Color chassis identical to CTC 15.

CORONADO (Gamble-Skogmo, Inc.) Models TV2-9694A to TV2-9699A and TV2-9730A use chassis identical to CTC 15.

CURTIS MATHES CMC 15 chassis identical to CTC 15.

DELMONICO CCTV-21 chassis identical to CTC 15.

DUMONT Chassis 120699, 120722 circuit and chassis layout identical to CTC 15.

ELECTROHOME C600 series chassis identical to CTC 15.

EMERSON Chassis 120699 and 120722 circuit and chassis layout identical to CTC 15.

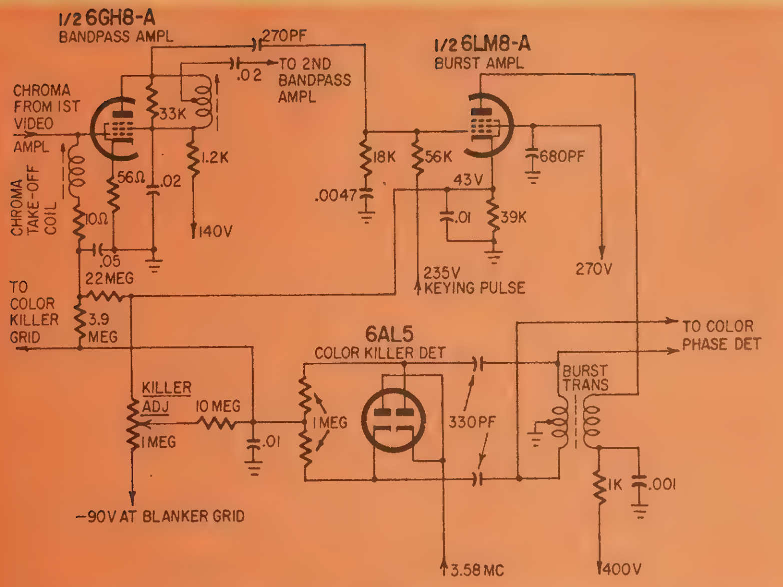


Fig. 2—Admiral's automatic color intensity circuit (automatic chroma control).

GENERAL ELECTRIC CA and FY chassis use circuit and layout similar to CTC 15 with minor variations in tube types and functions.

HEATH GR-53A. Kit similar in tube lineup and circuitry to RCA circuits with some differences in tube types and functions. Vertical chassis with printed circuits. Features built-in dot generator.

MAGNAVOX Series 45 chassis has 26 tubes and is similar in many aspects to the CTC 12. The SERVICE switch has three positions, NORMAL, SERVICE and PURITY. The PURITY position removes B-plus from the first and second i.f. amplifiers to allow full sweep without video interference or snow on the screen. The SERVICE position is used when setting CRT bias and temperature adjustments. It removes B-plus from the i.f. circuits and grounds the vertical sweep so only a horizontal line appears on the screen for each gun.

The dynamic convergence control panel mounts in an opening on the bottom of the cabinet. Remove two screws and it drops into the hand, ready for convergence adjustments from the front of the set. The cup over the neck of the CRT can be removed so it is not necessary to remove the set's back for purity or dc convergence adjustments.

Additional features in some models include a "quick-on" circuit that reduces warmup time to 12 seconds. A SEPIA control changes the picture-tube setup conditions so the basic color can be changed to a warm sepia tone. Automatic frequency control fine-tunes the receiver for best picture and sound and keeps it there automatically. A color indicator light is included in some models. The top end of the line uses the Sylvania Color Bright picture tubes for increased color brightness.

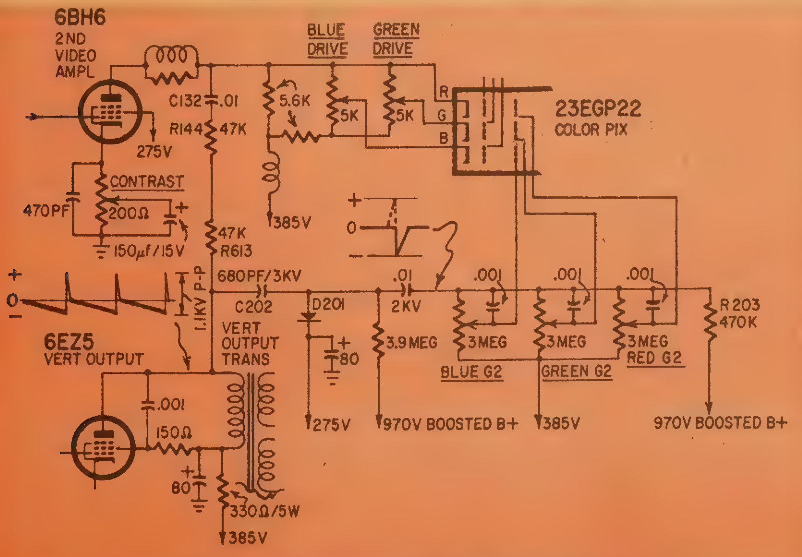


Fig. 3—The vertical blanking circuit used in Motorola sets.

MOTOROLA The 28-tube color sets use advanced versions of the WTS-907 chassis with the 21-inch round tube and the TS-908C chassis with the 23-inch rectangular tube. Versions of these chassis include such features as color indicator light, dynamic pincushion correction, and automatic chroma control. The chassis are fairly conventional with X and Z demodulation. They are handwired with plug-in subchassis quickly removable for tests or service.

The automatic chroma control circuit minimizes the effects of fast fading and airplane flutter. The circuit is similar to Admiral's automatic color intensity circuit in Fig. 2.

Vertical blanking

Vertical blanking prevents vertical retrace lines from appearing in the picture. The Motorola circuit is shown in Fig. 3. During the vertical retrace interval a high-amplitude positive pulse appears at the vertical output plate. This pulse is fed through R613, R144 and C132 to the cathodes of CRT and drives it to cutoff. These pulses don't last long enough to keep the picture tube cut off for the full retrace interval. Additional blanking is applied to the screens to keep the tube cut off for the balance of the retrace interval.

C202 and R203 differentiate the positive pulse into broader positive and negative pulses with the negative pulse following the positive. Diode D201 conducts and shorts the positive pulse (dashed lines) to ground. The negative pulse drives the CRT screens negative and keeps the tube cut off during the remainder of the retrace period.

MUNTZ No data received. Representative reports that the chassis is identical to CTC 15.

PACKARD-BELL The 98C8 chassis resembles various versions of the RCA chassis ranging from the CTC 11 to CTC 15. Features "Instant Color Purity" (pushbutton degaussing).

PENNCREST (J. C. Penney Co.) Four models using the WGEC series C600 chassis identical to the CTC 15.

PHILCO The 1965 N line includes the 15M90 and 15M91 color chassis. Both have 26 tubes, including the 21FBP22 picture tube. The 15M90's circuit is practically identical with the CTC 15 but the chassis layout and control positions are different. The 15M91 circuit is similar to the CTC 15 and CTC 16 with some differences in tubes and tube functions.

These sets have the new TT-166 four-circuit rotary switch tuner with a 6HA5 frame-grid rf amplifier and 6GJ7

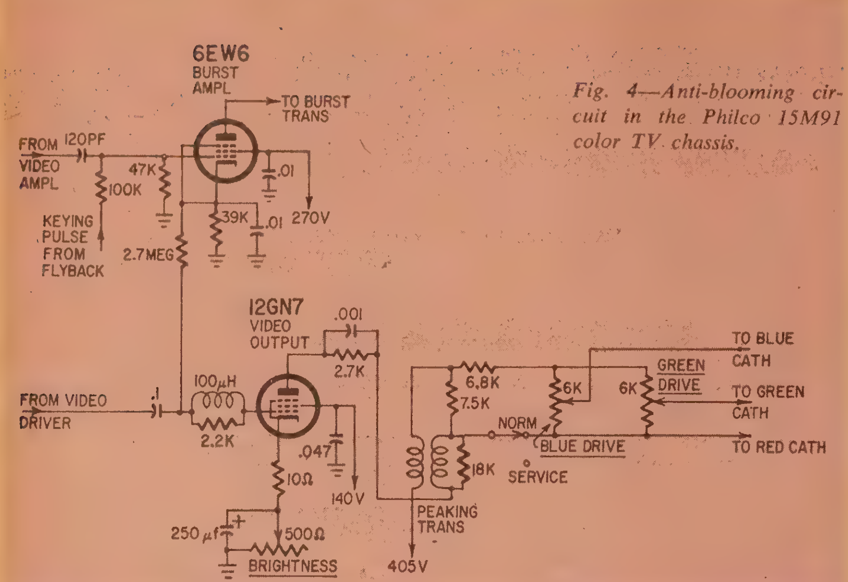


Fig. 4—Anti-blooming circuit in the Philco 15M91 color TV chassis.

frame-grid mixer-oscillator. A new fine-tuning mechanism and larger knob require more mechanical motion per kc of frequency change, thus making color programs easier to tune in. This new fine-tuning mechanism has enabled Philco to eliminate the video peaking switch. The viewer now gets the same results with a touch of the fine-tuning control.

Anti-blooming circuit

Blooming often occurs during sudden changes in picture brightness.

The anti-blooming circuit in the 15M91 chassis is shown in Fig. 4. A positive keying pulse from the flyback drives the burst amplifier grid and tends to hold its cathode at a fixed positive potential. This positive voltage biases the grid of the video output tube. On bright scenes, the high CRT current loads down the horizontal output circuit and reduces the amplitude of the keying pulse. This reduces the voltage on the burst amplifier and video output grid, biasing back the video amplifier and opposing any tendency toward abrupt changes in brightness or contrast.

The 6KA8 noise inverter, keyed agc and sync separator used in RCA and similar chassis has been replaced by a 6BH11 compactron in a more elaborate circuit less susceptible to noise. A 3AT2 compactron replaces the 3A3 high-voltage rectifier for greater reliability.

RCA The basic layout of the CTC 16 is similar to the CTC 15, with a number of circuit and design innovations. The full-wave voltage doubler in the low-voltage power supply has been replaced by a full-wave bridge. The bridge diodes are on the new audio circuit board in the spot formerly occupied by the 6AQ5 audio output circuit. The high-voltage compartment has been redesigned, with the shunt regulator moved to a more accessible spot to provide better ventilation. A 6BK4-A has higher dissipation than the 6BK4 that it replaces.

The 1V2 focus rectifier has been brought back after being replaced by a semiconductor diode in the CTC 15. The horizontal centering and focus controls have been moved from the high-voltage cage to the rear chassis skirt. The 6AW8 first and second video amplifier has been replaced by a 6FL8, a tube with the same electrical characteristics and base connections that has been especially selected and tested for positive-grid operation.

Automatic degaussing is used on all models except those in metal cabinets.

The new KRK 118 tuner is used in all 1965 color receivers. This is an improved four-circuit switch type with the channel 1 position wired as a two-stage i.f. amplifier for the output of the uhf tuner.

Convergence is the same as in the CTC 15. The convergence panel is now marked so each label indicates the function of the control and its effect on a cross-hatch test pattern.

SETCHELL-CARLSON Late models use the U800 Unitized chassis with a 21FJP22 picture tube. I.f. and color circuit similar to that in several RCA chassis. Some versions use 6AU6 first and second sound i.f. amplifiers, 6AL5 ratio detector, 12AX7 first a.f. and phase inverter and push-pull 6GK6's in the audio output stage. Others use a single 6AU6 sound i.f. amplifier, 6HZ6 quadrature sound detector, 6AV6 phase splitter and push-pull 6GK6's.

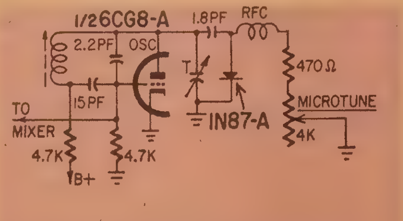


Fig. 5—Setchell-Carlson's Micro-Tune uses a variable-capacitance diode.

Setup and convergence controls are accessible from the front of the set. The chroma circuit subchassis can be removed for servicing while the set continues to produce black-and-white pictures.

The 6BK4 high-voltage regulator and picture-tube heaters are fed from an 8.3-volt winding on the power transformer. An 11-ohm resistor drops the voltage to 6.3 for the 6BK4. A 1-ohm resistor is used in series with the CRT heater. This resistor protects the heater against warmup surges and may be shunted out to act as a "booster" for aged, weak picture tubes.

The heaters of all other tubes are balanced across the halves of a 12.6-volt center-tapped winding. This eliminates heater current loops which might cause ripple in the picture. The chroma subchassis heaters receive power from both sides of the circuit so the board can be removed for service without disturbing circuit balance.

This chassis features a Micro-Tune fine-tuning circuit. A 1N87-A diode is used as a variable-capacitance diode. See Fig. 5.

SILVERTONE (Sears, Roebuck & Co.) Data received too late to be included.

SYLVANIA The 580-1 chassis is similar to the CTC 15. Most models use Sylvania's new "Color Bright 85" picture tubes for approximately 40% greater brightness. Sylvania recently announced the development of a special line of receiving tubes that will allow operating voltages in color sets to be reduced from 400 to 270. A 25-inch, 90° rectangular tube with the Color Bright phosphor may be used in Sylvania sets produced later in the year.

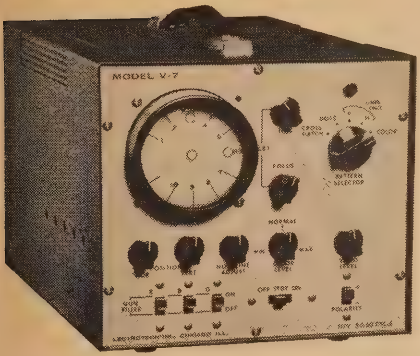
TRUETONE (Western Auto Supply Co.) Appears identical to CTC 15.

WESTINGHOUSE Same as Magnavox chassis. Convergence panel can be clipped to top rear edge of the cabinet so dynamic convergence adjustments can be made while observing the screen from the front of the set.

ZENITH Uses 25MC30 chassis, which is similar to the 1964 25CL20 with some changes in tube types. Early production models use 21FBP22 and 21FJP22 round picture tubes. A 25-inch, 90° rectangular tube has been announced for late production runs. END

Color Test Equipment

Lectrotech Model V-7 Color Generator and Vectorscope



THIS INTRIGUING NEW INSTRUMENT for servicing and setting up color receivers features an almost-all-transistor keyed rainbow generator which produces 10 color bars spaced 30° apart on the screen. The vectorscope gives a visual display of the bars' phases on the calibrated scope face. It is easy to tell whether these bars maintain the proper phase relationship through the color receiver. Setting up the hue or tint control circuits is simply a matter of lining up the scope pattern under the corresponding 1-to-10 calibration marks on the scope screen. As you rotate the hue or tint control, the pattern on the screen also rotates. B − Y and R − Y bars are specially marked for critical checking.

The size of the vectorscope pattern depends on the setting of the COLOR control on the receiver and on the COLOR LEVEL control on the V-7. With a little practice it is easy to determine just how the color gain compares to that of other receivers.

The color generator of the V-7 produces crosshatch, dots, vertical lines, horizontal lines and color bars.

An interesting feature is the HOR LINE ADJUST control for adjusting the width of the horizontal line from zero to four raster lines wide. This lets you adjust for the kind of bar that suits you best. A trimmer accessible through the side of the case sets the intensity of the vertical lines. Their width depends greatly on the high-frequency response of the color receiver, and so they can't be made quite as narrow as the horizontal lines. This is true of all color generators.

Three gun-killer slide switches let you turn each of the three color guns on or off independently. A color CRT adapter socket ties these switches into the circuit. The same socket also picks up the signals for the vectorscope so that there is no need to dig into the circuit for test points.

The color generator signals are coupled into the set through the antenna circuit. The rf output is factory-tuned for channel 4, but you can adjust for either channel 3 or 5 to sidestep interference in your area. Video output of either polarity is available through the video output cable.

All cables and adapters are conveniently stored in a compartment at the rear of the instrument. Inside the compartment there is also a screwdriver-operated switch for self-calibration of the color generator should the need arise. You can spot a faulty or off-frequency counter without opening the case—just turn the switch and count the number of pulses on the screen. I deliberately threw the counters considerably off frequency and realigned them in less than 5 minutes the first time!

About the circuits

The V-7 uses seven regular transistors, five unijunction transistors, two tubes and a 3-inch CRT.

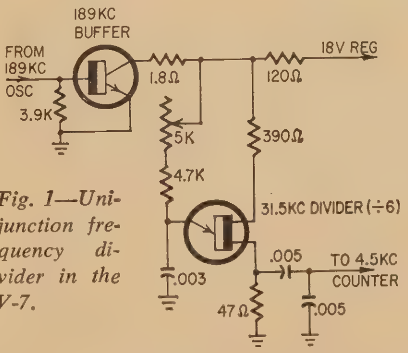


Fig. 1—Unijunction frequency divider in the V-7.

Controls: (scope) Intensity, focus, horizontal position, vertical position. (generator) Pattern selector; horizontal line adjust; color level; video level; video polarity; red, blue, green gun killer switches; off–Standby–on.

Patterns: Crosshatch; dots; vertical lines; horizontal lines; color bars.

Output: Rf channel 4 (may be realigned for channel 3 or 5); video either positive or negative 2 volts p–p (adjustable).

Output Leads: Rf; video; CRT adapter; ground clip lead.

Special Features: Self-calibration with built in scope. "Dial-A-Line" horizontal-line width adjustment. Test-lead compartment. Vector display of color signals (circular pattern).

Size: 8½ x 7½ x 13 in.

Price: $189.50

The heart of the generator is the 189-kc crystal-controlled transistor oscillator. This is the source for the counting oscillators and also supplies vertical line timing.

The big departure in this generator is the extended use of unijunction transistors as counters. The unijunction requires fewer parts than an equivalent tube counter, and timing is virtually unaffected by load or temperature, so it has good long-term stability and is easy to adjust (Fig. 1).

A 900-cycle flip-flop using two n-p-n transistors contains the horizontal-line adjustment that determines the output pulse width and consequently the width of the horizontal line.

Signals from the 15.75-kc and 60-cycle counters are combined in the sync mixer and then introduced into the diode modulator to provide a composite video signal that can modulate the rf carrier.

Color bars are generated by the offset-carrier method. A 3.56 +-mc crystal oscillator (½ 12AU7) exactly 15,750 cycles below the set's 3.58-mc oscillator produces a complete 360° phase shift for each horizontal scanning line. Since colors are demodulated in a color set according to phase, this gives us a complete "rainbow" of color. To provide "sense" to these signals, the display is gated into bars at 30° intervals. This actually makes 12 bars, but 2 are lost in sync and blanking so that only 10 appear in the final display.

Using the V-7

I connected the V-7 to a color receiver and, even though the instrument had been shipped by parcel post for several hundred miles, no touchup adjustments were needed. The dots, bars and crosshatch were stable and there was no evidence of any hum bar in the pattern.

I moved the "Dial-A-Line" control to see the effect. Turning the control all the way counterclockwise caused the horizontal lines to disappear completely. Turning the control clockwise made them reappear at the edge and center of the screen, and further turning made them overlap as more line width was added. I preferred using the instrument at the point where the lines just met. This gave a thin single-line display that makes convergence easiest, I think. The vertical line was stable without the least tendency to quiver at the top.

Up to now I was using only the rf output, by clipping onto the antenna terminals and adjusting the set for channel 4. Now I slipped the color CRT socket off and inserted the adapter between it and the CRT. I attached the black ground wire to the receiver chassis. This completed the connections for the gun-killer switches and also automatically supplied the pickup points for the vectorscope.

Switching the V-7 for color bars, I adjusted the fine tuning on the set for maximum amplitude of the pattern on the vectorscope. I rotated the hue control until the pattern lined up with the calibrated screen. I checked the color pattern on the set and found that the bar I always check for correct hue on (No. 4–magenta) was the correct color. It occured to me that here was an instrument that would let even color-blind people repair color sets!

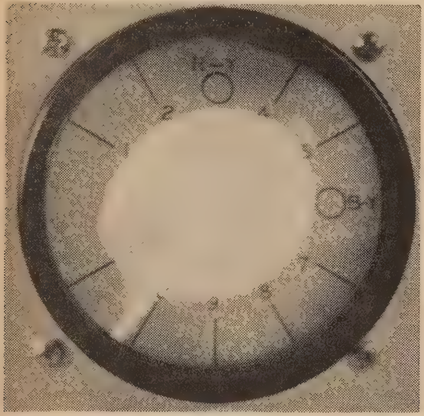


Fig. 2—Lack of color sync, as displayed on the V-7 vectorscope.

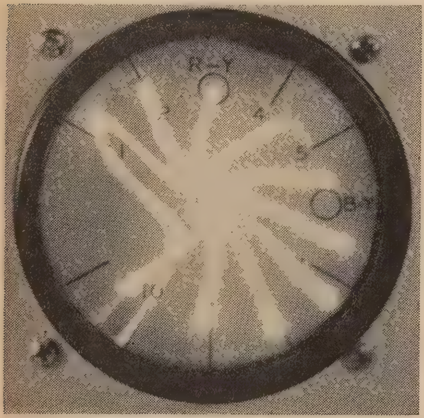


Fig. 3—Poor demodulator alignment.

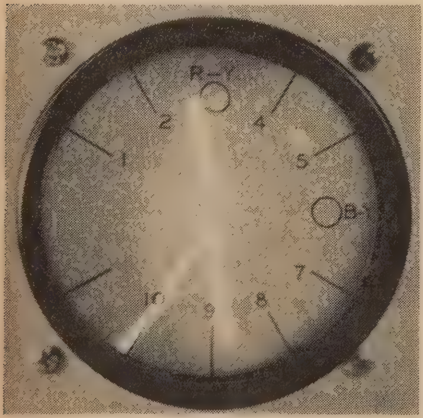
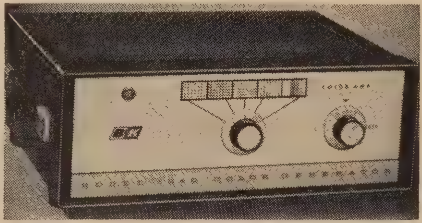


Fig. 4—Defect in Y demodulator or B — Y amplifier.

Figs. 2, 3 and 4 show the patterns you get on the vectorscope with different troubles.

I found only one thing I didn't like about the instrument and this sounds like caviling—a screw type catch is used on the test-lead compartment. You have to hunt up a screwdriver or a dime when you want to get inside or close up. I'd like a thumbscrew. You see, I'm one of those technicians who never has a dime!—*Wayne Lemons*

B&K 1240
Color-Bar Generator



COLOR BAR–DOT GENERATORS HAVE COME a long way from the original bulky "lab" type units. B&K's latest, the model 1240, is less than 1 foot square and only 4 inches high, yet it has all the facilities for making any kind of test or adjustment on color TV sets. The line cord and rf output cable wind up on handy hooks on the back of the chassis, and a carrying handle makes the unit easy to use in the home or on the bench.

Only two controls are on the front panel: the switch and color amplitude control, and the pattern selector. This instrument will make dots, vertical and horizontal bars, crosshatch patterns for convergence, and color bars. The color amplitude control will vary the color signal from "0 to 200%" for testing color afpc, bandpass amplifier response and ability to hold color sync. Normal or 100% setting is at 5 on the dial.

A 189-kc crystal oscillator controls seven multivibrators, counting down: 31.5 kc, 4.5 kc, 900 cycles, 180 cycles and 60 cycles. Also there's a 15.75-kc multivibrator for horizontal sync. A second output from the 189-kc oscillator makes the vertical line pattern through a keyer stage, and a third output through the same keyer makes the "white" bars. When these outputs are mixed with the color signals, they form the color-bar pattern.

A "keyed rainbow" generator (also crystal-controlled) is used to generate colors. It works at 3.563795 mc, or exactly 15,750 cycles below the burst frequency of 3.579545 mc. Or, "one line behind," so the color subcarrier goes through one full cycle or 360° of phase relationships to the burst, and makes all colors from red through blue to green. By keying this rainbow pattern with square-wave pulses, a color-bar pattern is formed.

The 450-cycle multivibrator provides the horizontal line pattern, and in this case, they mean "line". The horizontal lines are actually only *one* scanning line high! This is true of vertical lines too, so this instrument makes a very fine-line pattern for convergence, and very small dots if you like those better than the crosshatch. This requires careful adjustment of the receiver's fine tuning to get set up properly, but once set up you really have small dots to work with. Dot size is adjustable with a control on the back of the instrument, if you like 'em a little bigger.

Standard TV type tubes are used: seven 6CG7's, a 6AN8, a 6C4 and two 12AT7's. If you suspect any trouble in this instrument, check the tubes first, by replacement. *Never* tamper with any of the multivibrator adjustments. Ordinarily, it won't be necessary, but to keep temptation out of the way as much as possible, these are inside the cabinet!

A printed-circuit assembly is used for the multivibrator board and rf oscillator assembly, making a very compact chassis possible for the number of tubes used (11!). Plate power is supplied by a silicon rectifier and power transformer.

I happened to run into a swarm of color troubles while making tests on this instrument, and its compactness and ease of operation made a good impression. The "low silhouette" case design makes it possible to set the unit on top of the cabinet and still reach the convergence board over it without trouble. Soft rubber feet are used on the bottom and one side, so that it can be used in either position.

Rf output is ample, about 5,000 μv. The tuning is set on channel 4 when it leaves the factory, and an adjustable core in the rf coil allows tuning to either channel 3 or channel 5 if desired. The rf output appeared to be quite stable, in one long-run test I made, and the bar, dot and color patterns are very steady. The instrument costs $134.95.

Mercury 900
Color TV Analyzer

THE MERCURY 900 COLOR-TV ANALYZER is a plug-in instrument that can give the expert color technician a lot of information in a short time. Basically, it is a multimeter that can be connected into the picture-tube circuits. The socket of the color CRT is pulled and the analyzer connected between socket and base like a brightener.

By switching, all base voltages and currents (except for heater and focus-element current) can be read. A COLOR GUN switch selects one of the three guns;

an ELEMENT SELECTOR switch allows reading of heater voltage, focus voltage, cathode, G1 or G2 voltages or current. A METER OFF position shorts out the movement, for traveling.

A pushbutton changes the meter from voltage to current readings. Range switching is automatic, and the meter cannot be overloaded by being on the wrong range. A 200-μa movement is used, with two scales. The upper (black) scale reads 0–1,000 volts dc and 0–1,000 μa (0–1 ma). The lower (red) scale reads 0–7 kv for the focus element.

Three slide switches in the center of the panel are gun killers; any or all of the three guns can be turned off. This is very handy for gray-scale tracking, purity and initial convergence adjustments.

In the hands of the expert, this can be a very useful instrument. On older color chassis, where certain voltages are specified for the red gun, for example, for initial setup, they can be read with ease. To me, the most valuable feature is the instrument's ability to check color picture tubes in actual operation (always the best test). I had the opportunity of checking a picture tube known to be bad; the 900 confirmed the original diagnosis made by three good color picture-tube testers, and did it very rapidly. Very bad red gun, good green gun and weak blue gun.

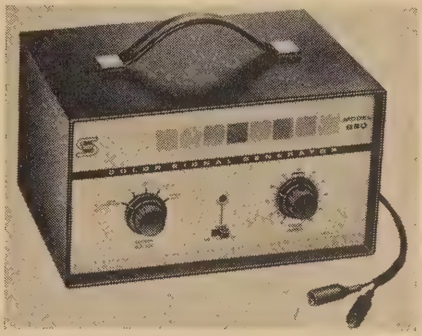
This test is very easy, and is made by simply measuring the cathode currents of each gun. If you read normal current on one gun (about 100–200 μa, low current on another and practically none on the last, then you've got a diagnosis: bad picture tube. All voltages, screen settings, etc., must be checked first, of course. A known-good color tube was also checked, to verify its good-ness, and it came out as expected.

Focus troubles can be quickly checked out, by reading the focus voltage and moving the focus control. Normal voltage, about 5 kv. The focus control should vary this between 4.5 and 5.5 kv. If it won't, you've got trouble. There are several focus-voltage circuits and adjustments in use, but the end result is still the same.

My only unfavorable reaction is to the length of the cables. They're just *not quite* long enough to allow you to set it on top of the cabinet! However, most color sets have ample space under the CRT to set it there, maybe the cables can be stretched just a wee bit!

The detailed instruction book gives all instrument settings, plus a list of typical readings in each position. These should be checked against the values on the schematic, of course. Service hints are also included for using the 900 for color-temperature adjustments and convergence. It costs $44.95.

Seco 980–990 Color Signal Generators



TWO NEW TEST INSTRUMENTS FROM Seco Electronics, of Minneapolis, are called simply "Color Signal Generators." Model 980 ($119.50) is the basic instrument, a dot–bar–crosshatch–color-bar generator. The model 990 ($149.50) adds such features as a gun killer for purity adjustment, and unkeyed rainbow color pattern and a gray-scale pattern.

Eleven tubes, all standard receiving types, and two crystals are used in the by-now familiar "countdown" circuit. Frequency dividers make the patterns, through shaper and clipper circuits. A difference in these instruments is the use of lower division ratios, allowing tighter coupling and greater stability than in other designs. From the 189-kc crystal, the frequencies used are 31,500, 6,300, 1,260, 420 and 60 cycles. For horizontal sync, 15,750 cycles is taken from the 31,500-cycle stage. Since this is only a 2:1 division, no adjustment is provided. The tight coupling makes it unnecessary.

Cathode-coupled multivibrators are used. The lower division ratios are claimed to give this instrument greater stability because the keying pulses can "get a better grip" on the lower-frequency waveforms. A variable control in the 31,500-cycle stage adjusts the horizontal frequency, and another in the 60-cycle stage trims the vertical frequency.

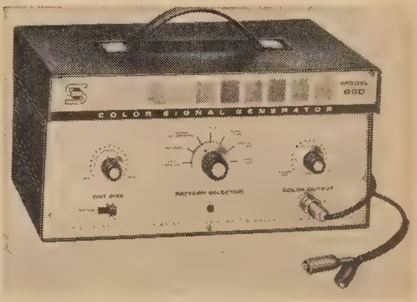
A "diode dot-gate" can be adjusted with a small trimmer to vary the size of the dots. The trimmer also affects the lines of the crosshatch pattern. This control, with the vertical and horizontal syncs, are on the back panel.

The color signal is the offset-subcarrier type, generated by a 3.563795-mc crystal oscillator. This is keyed by shaped pulses from the 189-kc oscillator into 10 color bars. A COLOR OUTPUT control on the front panel adjusts the bar amplitude from 0% to 200% modulation. The control is calibrated from 0 to 100, with "normal" at 50.

The rf oscillator is factory-adjusted on channel 3, and can reach channel 2 or 4. Rf output is at 300 ohms to match the input of a TV receiver, and signal output is ample.

The maker claims fast warmup and good stability, and this is borne out. I checked the generator on a previously warmed-up color TV set, and the color-bar pattern locked in in less than 45 seconds. It held for 30 minutes without appreciable drift, indicating very good rf oscillator stability. (Drift in rf on a color-bar pattern is easy to see: colors change and beats appear.) Later 1-hour tests on crosshatch and line patterns gave similar results.

Initial adjustment of the rf should be made on a working color receiver. Set the receiver up on a color program. Connect the generator and tune the rf for the correct color-bar pattern: orange at left, green at right. You'll note that the bars will "hook" at the top if you go too far; find this point, then back up slightly until the bars lock in, and that's it.



Seco 990

This instrument uses fewer bars and dots than others. Six horizontal lines (or dots) and nine vertical lines give 54 dots. The maker claims that the lower number reduces clutter on the screen and makes counting bars for width and height adjustments, overscan, etc., easier. I agree. The lines and dots are very small, by the way, giving good resolution.

A compact and well built instrument, it has a carrying handle, and hooks on the back for winding up the line cord and the rf output cable. You *do* know that such instruments are handy for black-and-white TV servicing, don't you? The crosshatch patterns check linearity, and the color-bar pattern makes a dandy video signal for tracing all the way through a set! Its distinctive appearance makes it easy to see on a scope.—*Jack Darr* END

No-Instrument Checks for Color TV

Eyeball tests can tell you where the trouble is

By JACK DARR

SERVICE EDITOR

THERE'S A SIMPLE PROCEDURE FOR checking out a color TV set. It's actually the same checklist used by the expert color technician when he makes those all-important preliminary tests. These things must be right, before we *can* do anything else. Just as in black-and-white TV, the action of the controls tells us a lot about where the trouble is or, more important, where it *isn't.* So let's go through this checklist, in plain English, one thing at a time.

Some of this may sound a bit elementary, but don't let it fool you. I have made many a color service call to do nothing more complex than turn down the contrast control! (It was more fun before they got smart and hid the color-killer control.) These are all eyeball tests: no test equipment needed. From the results, we can tell what is wrong, if anything.

Tuning-up

Do *you* know how to tune a color TV set? A lot of people don't, simply because no one has ever showed them! (This is one of the installer's main jobs: he should show the set owner how to *run* it!) It's simple, really. Tune just as in black-and-white. Then turn up the color control till you see color in the picture. (This is easier if the show is in color, of course!) Now, check people's *faces.* If they don't look people-colored, adjust the tint control till they do.

Always set the tint control on human faces—never on any other colored object in the picture. Turn the color control up or down to get a natural-looking picture. Finally, recheck the fine tuning; if it isn't exactly right, you may have trouble. That's all there is to it.

Checklist for new installations

Let's see what a new set ought to do if it's properly installed and adjusted. First, it must make a *good* black-and-white picture. No blobs of color on the screen, no colored fringes around objects at normal viewing distance. (You can put your nose right up to the screen and see a little fringing in most of them, around the edges—100% convergence is almost impossible, although some of the new sets get awfully close to it.) However, if the picture looks "clean" at normal viewing distances, fine. Remember, *all adjustments on a color set are made to get a good black-and-white picture! If these are correct, then the color will take care of itself.* Now let's run through the operating controls and see what their normal reactions ought to be.

The operating controls

1. Brightness. From blackout to a "too-bright" screen. The picture should bloom very slightly and may go out of focus at "full-up". This is normal. Watch closely to be sure that the picture stays black-and-white at all usable brightness levels—no tinting.

2. Contrast. Just like black-and-white. Normal setting, in all but the very latest models, is full *off!* Full-on contrast will give a harsh picture and very bad *apparent* misconvergence! This is normal, too.

CHECKLIST FOR GOOD COLOR INSTALLATION

1. Picture: good black-and-white, no color tinting. (Color temperature)
2. No colored areas on screen. (Purity)
3. No colored fringes around objects. (Convergence)
4. Color control: Covers range from off to too bright.
5. Tint control: makes faces go from greenish to reddish.
6. Fine tuning: goes from "worms" to black-and-white picture.

3. Color. Off, for black-and-white pictures. As you turn this control up, the colors should gradually get more vivid (go from pale pastel to bright and glaring). There must be no change in the color (hues) themselves, only in their intensity. This is a "color volume control."

4. Tint or hue. This one *changes* the colors. Normal range: human faces should go from a sick greenish color at one end, to a purplish-red at the other, sort of a cross between a bad sunburn and an alcoholic's nose. Somewhere in the middle, faces will be "natural-looking."

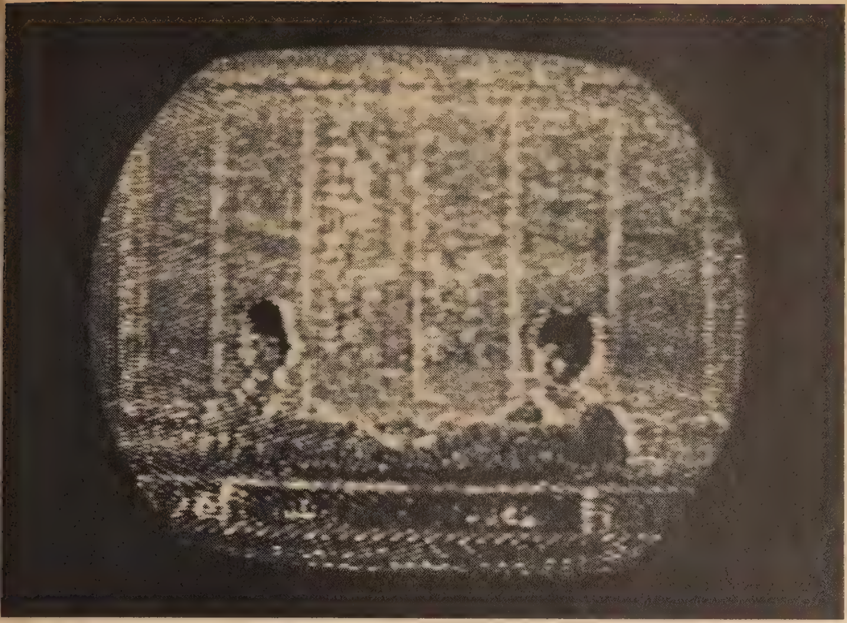
5. Fine tuning. This one is important in color. Turn the fine tuning through its full range on a color show. At one side, you'll see sound in the picture and get "worms" as in the photos. At the other side, you'll lose the color and get a slightly smeared black-and-white picture. Correct setting: tune into the worms, then back up until all of the "wiggles" are out of colored objects and you have nice smooth color. Leaving the fine-tuning too near one side or the other can cause color dropouts, or worms in the picture, from normal warmup drift of the tuner oscillator. Set the knob as close to the center of the color range as you can.

Troubles that aren't

Before we go any further, let's look at some troubles that aren't troubles at all. Every one of these has caused unnecessary service calls.

Temporary dropout or shift of color in the middle of a show: Most common cause, network or station trouble. If this happens often, say at least three times during a half-hour color show, there may be an intermittent tube in one of the color circuits. Once or twice a day isn't uncommon for this. Always check it on at least three color shows before doing anything drastic.

Differences in color between two



Two shots with "worms" (beats) in them. The wiggles appear when the fine-tuning control is too far into the sound portion of the TV channel. The "worms" are actually multicolored. (Lower photo is a closeup.)

TV stations—not at all uncommon! It's lue to differences in transmitters, operators, network amplifiers and so on. One station can have "very strong color" while another can be very pale, on he same show. This is *not* in the set! As ong as you *can* get good color by read-usting the color control, or even the int, fine. If you find a station with chronic color troubles, write nasty let-ers to its chief engineer, but don't tear nto the set!

Sudden color troubles ("It was working fine when I turned it off!"): Such troubles as no color at all, apparent misconvergence, worms in the pic-ure, etc. First check *all* the operating controls. Children and unqualified "technicians", like your brother-in-law, may have turned some of the knobs. Don't panic. I barely avoided a 20-miler late one night when a customer screamed into the phone, "The thing won't light up!" Since this was a new set, I suggested tactfully that he try the brightness control. After some discussion, he did, and I could hear him from all the way across the room: "———!" Someone had turned the brightness control all the way off.

If there is a chronic tinkerer in your family, you may even have to check the rear controls, too. Find out for sure what has happened; we'll give you the methods in a minute. If there *is* a real "sudden trouble", it is almost sure, on percentages, to be a single bad tube. *Don't* make any adjustments to the rear controls at random. There are ways to tell what has happened.

What not to do—the "Mussentouchits"

Let's get one thing straight first: there are certain things on a color TV set that should *never* be adjusted without cause, and even then only when a full set of test equipment is on hand. Actually, they very seldom cause trouble, because of the way they're built.

Here they are: tuning adjustments on rf, i.f. and above all, the color circuits; and the little slugs in the transformers. (Random Experimental Adjustments on any of these means a trip to the service bench and a full realignment!) The expert never adjusts them until his tests have shown that they need it.

Tubes

Tubes can be replaced, one at a time, if they are stone cold and dead. This is the best way. Set owners should be warned about taking out all the tubes and trying to test them at the supermarket! This results in mixing up i.f. tubes and such, and could cause misalignment. Besides, those tube testers are seldom accurate enough to evaluate a set of tubes in such uses! The value of tube testers depends a great deal on the skilled *evaluation* of the results. Single tube replacements—watching to see if there is any improvement in the set's performance—is still the best way.

Convergence

This is one of the final Mussentouchits. Convergence adjustments must be left strictly alone, unless you have a good, stable bar-dot generator. Don't *ever* try to reconverge or to "touch up" these adjustments on program material! You must have a stable pattern of some kind, and TV program material is always moving. Another caution: when working around the back of the set, don't let your elbow hit the convergence yoke or blue lateral magnet! If you knock them out of place, you'll *have* to reconverge!

With this article we've printed a 'checklist' for color TV installations. A good installation will meet all those standards. You might cut it out and paste it near your set, or otherwise keep it handy.

There's more, of course, but there isn't space for it all now. In another article, we'll talk about color-temperature adjustments, the middle-aged TV and about color picture tubes. And finally, a grand overall checklist that covers about all the color troubles you can check and remedy without test instruments. END

SOLAR CELL CIRCUITS

You can use silicon solar cells instead of batteries for many circuits—better than batteries for some.

By DONALD L. STONER

SILICON CELLS HAVE ARRIVED, AND THE aerospace industry and the military lean heavily on them. But the glamorous military and scientific applications for solar cells are not the only ones! You can build many novel but practical circuits for home and shop use with silicon solar cells.

One example is a transistor oscillator, an extremely low-power application for photovoltaic cells. The oscillator in Fig. 1 is designed to operate from a small single silicon cell as a power supply. Good room illumination may be enough to operate it.

The output frequency of the wide-range, light-powered audio oscillator in Fig. 2 may be varied by adjusting the 10-meg potentiometer. The circuit can generate any frequency between 1 and 1,000 cycles without switching. The illumination on the photocell should be at least 100-foot-candles. Output may be increased by using two or more photocells in series.

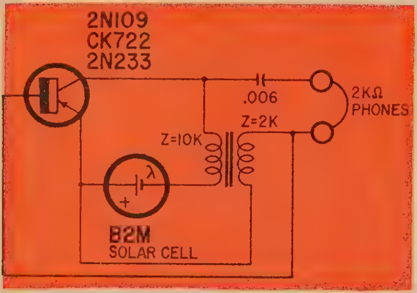


Fig. 1—*Audio oscillator will work with almost any light stronger than 10 foot-candles.*

Tunnel diodes, too!

While on the subject of oscillators, consider the unusual and useful tunnel-diode power supply of Fig. 3. Tunnel diodes require 200 to 400 mv of dc. This voltage is easily obtained from a single silicon wafer. Further, many tunnel-diode circuits require a low-source-impedance power supply and that is another characteristic of the solar cell. In Fig. 3, lamp position and distance are adjusted for the correct tunnel-diode operating point. The cell should be heavily bypassed to prevent modulating the oscillator signal with 60-cycle ac.

The radio circuit in Fig. 4 was designed to work with a single solar cell, and does so under surprisingly low illumination. A level of 10 foot-candles will produce good volume in an ordinary pair of 2,000-ohm headphones. In a typical location in Los Angeles, it received four stations clearly. Under optimum conditions, the receiver will drive a four-inch speaker. To use one, connect the highest-impedance primary terminals of a universal output transformer in place of the phones and connect the speaker across the lowest-impedance secondary taps.

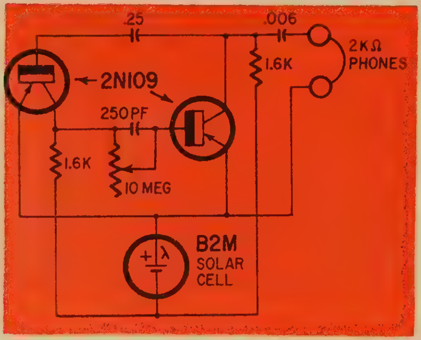


Fig. 2—*Wide-range audio oscillator is sun-powered multivibrator.*

The ferrite antenna comes with its own 18-inch length of wire, which when unwound acts as an antenna. Using only this antenna, the receiver will bring in one or two stations with adequate volume in most locations. Adding 10 or 20 feet of ordinary "zip-cord" to the 18-inch wire brings in more stations with greater volume. A ground improves the performance further. It can be a wire connected from the ground end of the antenna coil to a water pipe or to a metal rod driven into moist earth.

A sun relay

One obvious application for solar cells is to energize relays when the solar cell is illuminated. Such a circuit is shown in Fig. 5. Four solar cells are connected in series across a Sigma type 5SS 1,000-ohm relay. This combination produces a "sun relay" that functions when exposed to direct sunlight, without any other source of power.

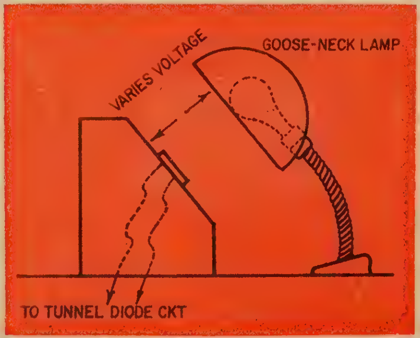


Fig. 3—*One of the simplest imaginable variable-voltage, low-impedance power supplies!*

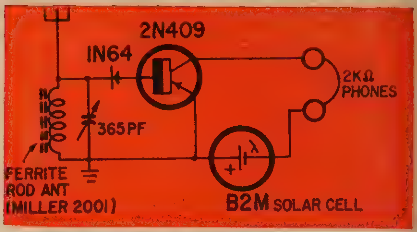


Fig. 4—*A remarkably sensitive AM broadcast receiver uses one transistor and one solar cell.*

Using transistors boosts the sensitivity (Fig. 6). Adjust the operating point by setting potentiometer R to turn the relay on or off at a desired light level. Decreasing R decreases the sensitivity. Your choice of a relay depends on the performance you need. The coil resistance should be a reasonable match for the collector resistance of the output transistor, which may run from 1,000 to 10,000 ohms with a 9-volt battery.

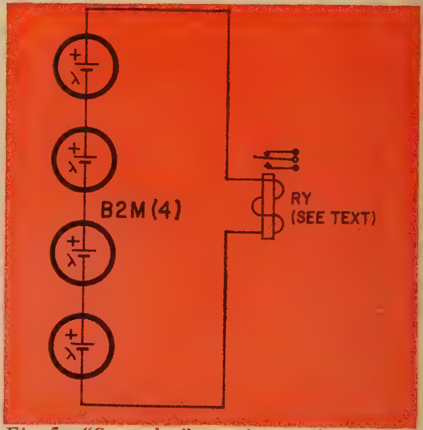


Fig. 5—*"Sun relay" uses four cells in series. One cell might do for more sensitive relays.*

Beam-of-light detector

A light-beam transmitter-receiver is shown in Fig. 7. It varies the intensity of the light source with voice or music, and a solar-cell receiver can convert the modulated light into electrical energy. This current can then be reproduced as sound in a pair of headphones. The lightbeam transmitter uses an ordinary flashlight lamp and carbon microphone. BATT3 keeps the lamp lit. The modulating voltage, which either aids or opposes BATT3, comes from the transistor through a matching transformer, T2. This transformer can be any 6.3-volt 0.5 ampere unit with the 117-volt winding connected to the transistor. Microphone transformer T1 is identical to T2, but with the 6.3-volt winding connected to the microphone through a small battery

(BATT1). A Stancor type A-3856 may be used for T1 and T2. Mount the lamp so that its beam is horizontal and can be aimed in any direction.

The light-beam receiver receives electrical energy from the solar cell and amplifies it with a two-transistor amplifier. Transformer T may be a Stancor type A-3250 or a Triad type T-23 tube-to-line unit with a 25,000-ohm primary impedance and a choice of secondary impedances from 125 to 600 ohms. The earphone connections should be made to the 500 or 600-ohm secondary terminals.

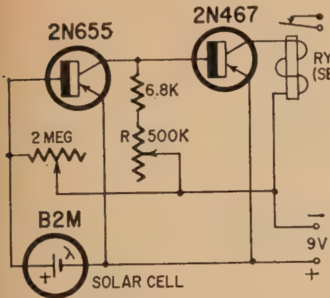


Fig. 6—Transistor dc amplifier boosts relay senistivity.

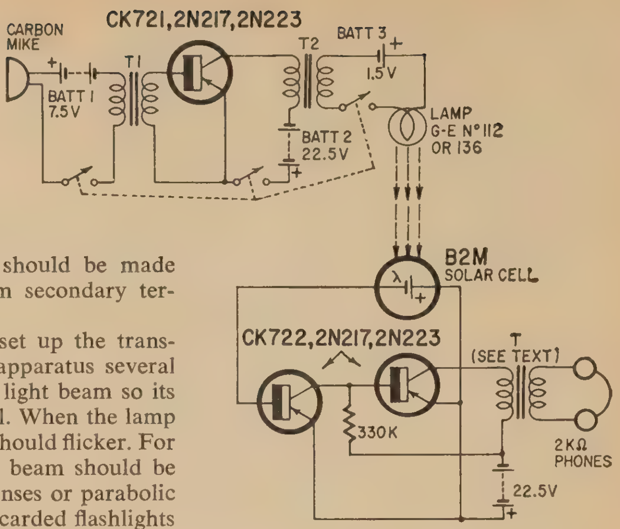


Fig. 7—Light-beam transmitter and receiver works nicely across dimly lit room.

To test the unit, set up the transmitting and receiving apparatus several feet apart and aim the light beam so its center hits the solar cell. When the lamp is modulated, the light should flicker. For greatest sensitivity, the beam should be sharply focused with lenses or parabolic reflectors. A pair of discarded flashlights would make an excellent transmitting and receiving "antenna".

The many applications for silicon solar cells are limited only by your imagination. Several novel and interesting uses are described in the *International Rectifier Solar Cell and Photo Cell Handbook**, by John Sasuga. I thank the International Rectifier Corp. for permission to describe a few of the more popular circuits. END

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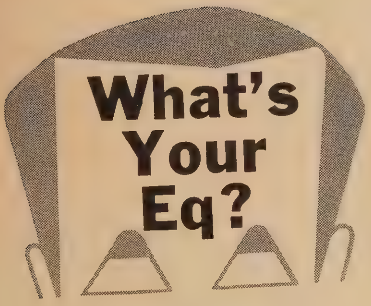
*Available from International Rectifier Corp., El Segundo, Calif. $2.



What's Your Eq?

Conducted by
E. D. CLARK

Three puzzlers for the students, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay $10 for each one accepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.

Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N. Y. 10011.

Answers to this month's puzzle are on page 97.

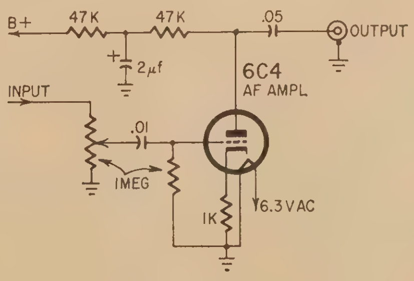
Which Motor?

You are working in a tropical location where it becomes necessary to ventilate a transmitter building. The building is a good 5 miles out on the boondocks, and you have to order a squirrel cage fan and motor assembly, to be installed yesterday.

You know the building has three-phase service, Y-connected, with 120 volts from each phase to ground, which was specifically set up for your equipment. You have available in the warehouse 208-, 220-, and 240-volt three phase motors. Which do you order?—*Eugene Austin*

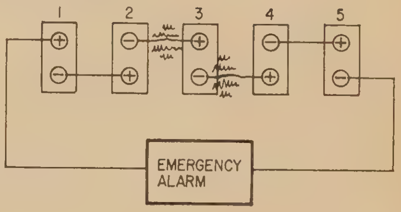
Hum-m-m

An FM kit tuner has two outputs—one direct from the ratio detector, and the other from a triode amplifier with volume control. Detector output is normal, but the output from the amplifier has an abnormal amount of hum even with the volume control at minimum.



Shorting either grid or cathode to chassis (volume control advanced) increases the hum, but by shorting both to chassis, the hum is eliminated. The tube and all components check good and all voltages are normal. What's causing the hum-m-m?—*E. D. Clark*

Emergency



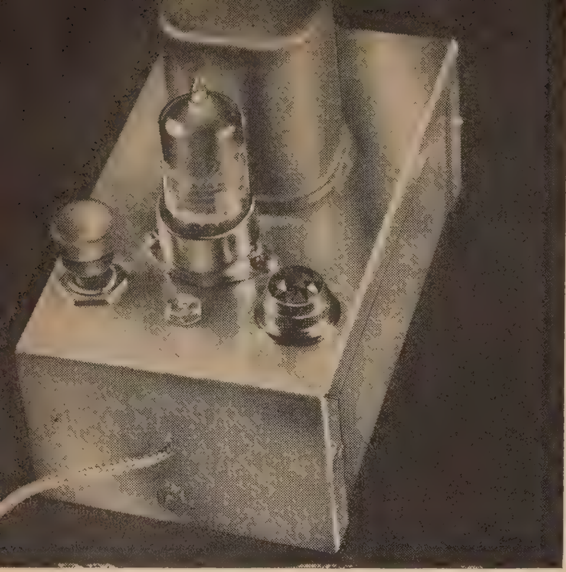
A number of heavy-duty wet cells are wired in series and feed an emergency alarm system. The No. 3 cell and connecting straps are corroded and apt to fail at any moment. The emergency alarm will still function with one cell removed from the circuit, but we must constantly maintain current flow through the emergency alarm.

The problem—how can we remove No. 3 cell and its connecting straps without shorting the battery or interrupting current flow through the circuit? —*Henry J. Neibert*

50 Years Ago

In Gernsback Publications
In January, 1915,
Electrical Experimenter

Wireless Telegraphy From Aeroplanes.
Short Wave Receiving Jigger or Loose Coupler.
Selenium and Talking Pictures.
Wireless Storm Detector.
Acoustic Radio Amplifier.
Why the Radio Amateur?



Program your stereo recorder with comments on one track, beeps on the other, and show your slides automatically!

The Pushbutton Projectionist

By NELSON S. BROOKS, W2DQG/DL4VQ

FEW HOBBIES ARE MORE POPULAR TODAY than color photography and stereo sound. An ever-growing number of homes contain a color slide projector and a stereo tape recorder. These two seemingly unrelated devices can be coupled to provide completely automatic color slide projection in accordance with a preplanned program, and accompanied by a pretaped narrative description of each slide as it's projected.

The linking device is simple and, with the possible exception of the high-resistance relay, can be constructed from any well stocked junkbox. Although practical values are given for all parts, none are critical except resistor R9 in Fig. 1. This value may have to be determined experimentally as described later.

Substitutions can be made within fairly wide ranges for all other parts. Although a 1N34 diode is shown as D1 in Fig. 1, any one of a dozen junkbox diodes tried worked well.

The use of this device does depend on the availability of a stereo tape recorder and a slide projector that can be cycled by electrical contact. A number of such projectors are in common use, generally of the type which permits remote-control slide changing with an extension cable and pushbutton switch.

While fully automatic slide projectors are commonly available, they project each slide for a fixed, preset time. This does not permit random timing of individual slides without manual intervention. If you intervene, the system isn't automatic any more. If you don't, more interesting or detailed slides can't be given extra projection time. This device not only permits each slide to remain on the screen as long as required, but also provides a fully synchronized taped narrative for each picture.

One channel of a prepared tape is used to control the cycling of the projector, and the other for the commentary.

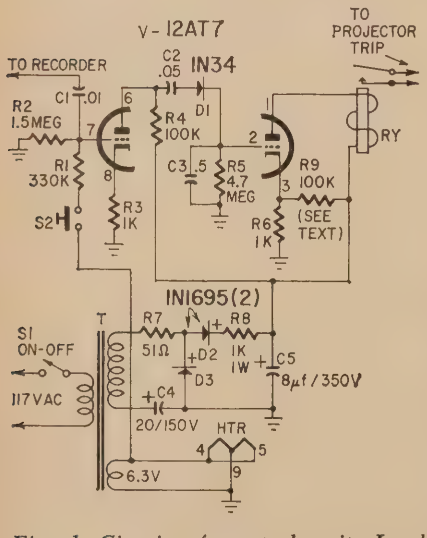


Fig. 1—Circuit of control unit. Lead marked "to recorder" connects to recorder's channel B input or output, depending on whether you are recording or playing back.

C1—.01 μf, 600 v
C2—.05 μf, 600 v
C3—0.5 μf, 200 v
C4—20 μf, 150 v, electrolytic
C5—8 μf, 350 v, electrolytic
D1—1N34 germanium diode or equivalent
D2, D3—400-piv silicon rectifier (1N1695 or equivalent)
R1—330,000 ohms
R2—1.5 megohms
R3, R6—1,000 ohms
R4—100,000 ohms
R5—4.7 megohms
R7—51 ohms
R8—1,000 ohms, 1 watt
R9—See text
All resistors ½ watt, 10% except as noted
RY—spst N.O. relay, 10,000-ohm or higher-resistance coil (Sigma 4F, Potter & Brumfield LM5, etc.)
S1—spst on–off switch
S2—spst N.O. pushbutton
T—small power transformer, 125–150 v, 15–20 ma; 6.3 v, 0.3–0.6 amp (Stancor PS-8415, Merit P-3046 or equivalent)
V—12AT7 (see text)
Case—Minibox, 2 x 3 x 5¼ in. (Bud CU-3006A or equivalent)
Socket, shielded lead, miscellaneous hardware

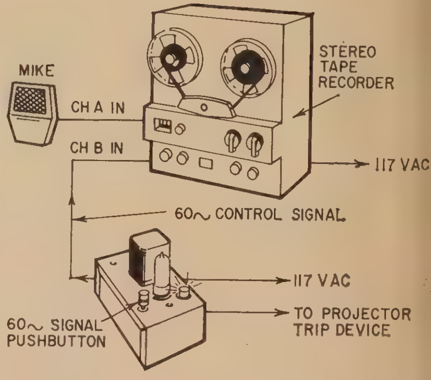


Fig. 2 – Recording hookup. Organize your slides, speak into mike as you see each one projected. Finish your remarks for that slide, push the button. Projector shows next slide, and signal appears at proper point on "control" channel for later use.

I originally considered using a control signal of a frequency high enough to be inaudible. While this offered the advantage of operation with a monophonic tape system, it required a high-frequency tone generator to provide the control signal, and an audio filter in the control device to restrict response to the control signal. Here, an internally available 60-cycle low voltage is used for the control signal and one channel of the tape recorder is a control channel exclusively.

The control channel of the tape is prepared by applying a small ac voltage through the pushbutton switch to channel B of the tape recorder (Fig. 2). In the control box, this same voltage is amplified, rectified and applied to the grid of the control tube, increasing its plate current. This current flow actuates the relay which, in turn, cycles the projector. As each slide is projected, record a description on channel A of the tape.

As indicated in Fig. 3, automatic operation of the projector results from substituting the prerecorded 60-cycle control signal for the ac voltage previously applied manually. For this, transfer

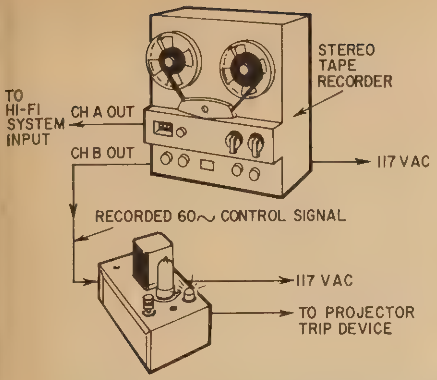
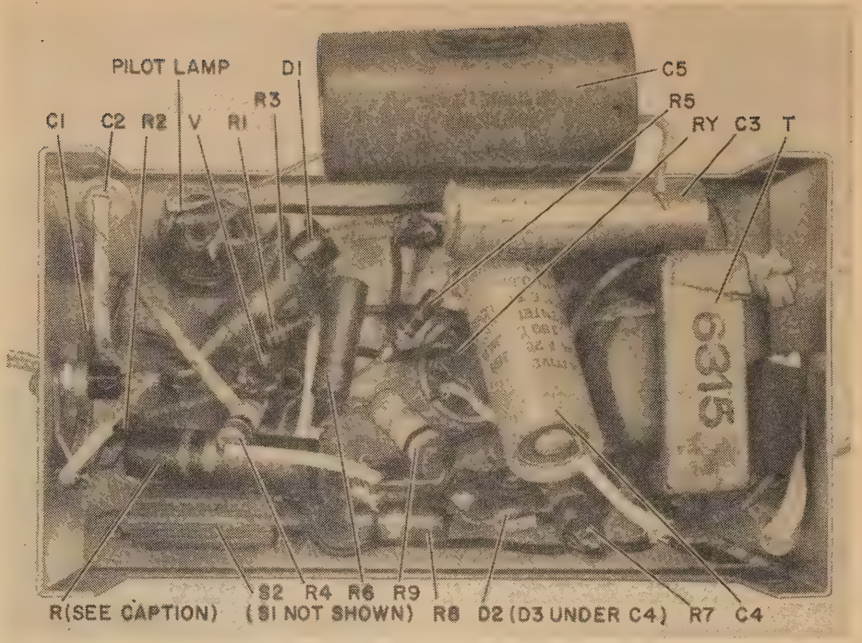


Fig. 3—Setup for a slide showing. No mike, no attention needed. Commentary plays through hi-fi system. Control signals on other channel are not heard, but trip projector at correct moment.



Author Brooks says "I certainly am not proud of the interior . . ." It was wired hurriedly in a place where facilities were poor. Resistor R is bleeder author used to lower B-plus at high line-voltage in his area. Selecting R9 according to text will do just as well. C5 was moved away from its normal position for visibility.

the connection between recorder and control box from the input to the output side of channel B of the tape recorder. At the same time, channel A is fed through the hi-fi system. Now the inaudible channel of the tape controls the projector while the sound channel provides accompanying commentary through the hi-fi system.

The circuit is simple, with a minimum of parts. The tape is prepared by applying the 12AT7 heater voltage through a pushbutton switch and a voltage divider (R1, R2) to the grid of one 12AT7 section. At the same time, this voltage is applied to the channel-B input of the tape recorder.

From this point on, the operation of the control unit is the same regardless of whether a tape is being prepared or played back. The only difference is in the source of the signal—manual, direct, for preparation, and automatic, recorded, for playback.

Whether or not you need the input section of the 12AT7 depends on the voltage output of the tape recorder. In my case, the control unit is driven by a low-output tape deck, so additional amplification was necessary to obtain sufficient positive bias for the control tube. A high-level tape output may not need that extra gain. In that case, ignore half of the 12AT7 or use a 6AB4 or 6C4.

The unit is built in a 2 x 3 x 5¼-inch Minibox. The relay, tube, pushbutton control switch and indicator lamp are mounted on top of the box. The transformer and other parts are inside it. The transformer does generate a little heat after an hour's use and could well be mounted on top of the box where both space and air circulation are available.

Left to itself, the tube draws enough current to keep the relay closed at all times whether or not a control signal is present. By placing a positive 4 volts on the cathode of the tube through R9, plate current sufficient to close the relay flows only when voltage on the grid is positive.

A value of 100,000 ohms for R9 may be correct, depending upon the voltage applied to the plate of the tube, the resistance of the plate relay and the value of the cathode bias resistor. You can make initial tests without R9 (or the tape recorder).

With power on, apply a signal voltage by closing S2. If the relay closes and opens upon pressing and releasing the switch, the unit is ready. If the relay does not close, despite the appearance of positive voltage on pin 2 of the 12AT7, either the cathode resistor at pin 3 should be decreased or the plate voltage raised.

If the relay closes as soon as power is applied and regardless of whether or not a control signal is present, R9 can be inserted. Temporarily connect one side of a 500,000-ohm potentiometer to the supply voltage, and the arm of the potentiometer to pin 3 of the 12AT7. Vary the resistance until you find the point where the relay releases with no control signal applied. Measure this resistance, and insert a resistor of about this value in the circuit permanently. A control signal should now close the relay.

The unit is now ready for operation, so prepare a tape of your favorite slides and await the arrival of company. When the opportunity presents itself, plug the units together and turn them on. While pictures flash to the accompaniment of your witty comments, you're free to mix drinks, put the baby to bed or expel unruly spectators. END

ON THE COVER

The color bar pattern transmitter on our cover was designed by Motorola, Inc., for its Franklin Park plant production lines, as part of the quality planning and control supporting the new Motorola rectangular-tube color television receiver.

Walter B. Scott, vice president of manufacturing for consumer products, explained that the normal color bar transmitter—used for routine checks—was not critical enough of a good color product. So the factory's test lab designed, built and is using this new color bar generator.

All transmitters were transistorized and modernized to remove the heat generated in these complicated racks of equipment. Circuits were stabilized and the company believes it now has the most modern transmitter setup in the industry—it is even air-conditioned.

The new color bar generator has two upper bars of orange and blue. These "I" and "Q" bars are used as a reference in aligning the set for best color. The next line of color squares is to determine accuracy of color phasing and color reproduction. The shaded black and white squares are used to evaluate black, white and shades of gray—response of the black-and-white channel.

The narrow vertical color bars help evaluate the capacity of the set to render true color fidelity with short repeated bursts of color. The bars are compared with the larger color squares two lines above.

More Range From CB Rigs

How sideband suppression works, and why it gets more useful power from those 5 dc watts

By ROBERT F. SCOTT
TECHNICAL EDITOR

Regency's Range Gain CB transceiver.

TALK POWER IS THE KEY TO SUCCESSFUL CB operation. Increase it, and your coverage in dead spots and fringe areas is more reliable and effective. You can increase your talk power by maintaining a higher average level of modulation[1] or by switching to one of the new CB rigs that provide more sideband output (talk power) while holding the power *input* to the 5-watt limit set by the FCC.

Conventional AM CB transceivers and transmitters produce a signal that consists of a carrier and upper and lower sidebands. Two-thirds of the output power is in the carrier and one-third is divided between the two sidebands. Thus, if we have a 5-watt (input power) rig with 60% efficiency, the power output is 3 watts. There will be 2 watts in the carrier and ½ watt in each sideband.

The carrier does not carry intelligence. It is used only to generate the sidebands in the transmitter and as a reference signal for the detector in the receiver. Both sidebands contain the same information, so we need only one "to get the message."

Therefore, for greater talk power with the same power input, we have two alternatives. One is to reduce the carrier power until it is just strong enough for reliable detection in a conventional receiver and concentrate the remaining power in the sidebands. This is DSBRC (*d*ouble-side*b*and *r*educed-carrier) operation. The other alternative is to suppress the carrier and one sideband and put all the available power in the remaining sideband. This is the single-sideband suppressed-carrier mode—better known as SSB.

Single-sideband operation has several advantages. It needs only half the channel space used by conventional AM for the same amount of information. This makes it possible for two SSB stations in the same area to share the same channel at the same time if one transmits on the upper sideband and one on the lower.

Since only one sideband is received, a receiver for SSB needs only half the i.f. bandwidth of one for conventional AM. A receiver's noise output is proportional to its bandwidth; so narrowing the bandwidth for SSB improves the signal-to-noise ratio.

SSB signals cannot be read on ordinary AM transceivers because AM detectors require a carrier for the detection process. Because pure SSB transmission would make existing CB receivers useless, some of the carrier must be left in.

Now, let's take a look at two new CB transceivers, one using DSBRC and the other SSB.

Regency Range Gain

The Range Gain DSBRC transceiver is a 23-channel unit that uses 11 crystals and frequency synthesis for crystal-controlled reception and transmission on all 23 CB channels. (The frequency-control circuits are similar to those covered in the article "Frequency Synthesis Improves CB Coverage" in the August 1963 issue.)

The receiver is a double-conversion superhet with a 7.5-mc first i.f., 260-kc second i.f., automatic noise limiter, squelch and push-pull 6AQ5's as the audio output and modulator. A "delta-tune" (bandspread) control tunes the receiver over a range of ±3.5 kc to

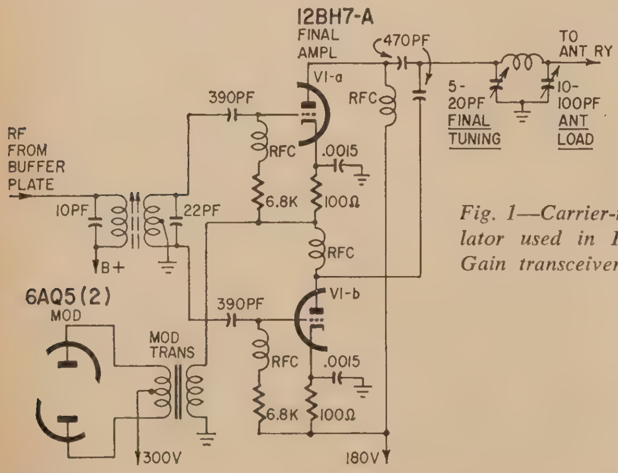


Fig. 1—Carrier-reducing modulator used in Regency Range Gain transceiver.

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[1] *"More Talk Power for Your CB Rig,"* RADIO-ELECTRONICS, *October 1963.*

compensate for in-tolerance variations in the frequencies of the stations being received.

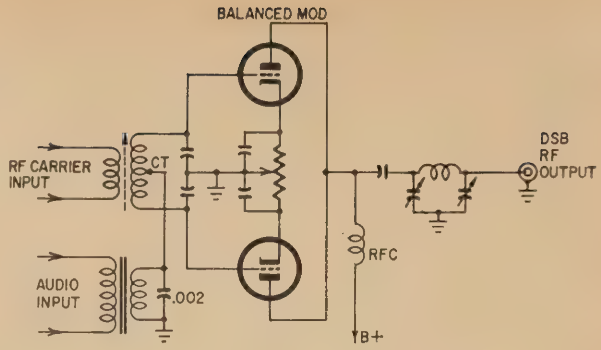

Fig. 2—Basic balanced modulator with "push-push" triodes. Pot in cathode circuit adjusts carrier balance.

Carrier suppression

In the transmitter, the frequency-control network feeds a *modified* balanced-modulator output stage through a buffer amplifier. The circuit of the final amplifier is shown in Fig. 1. This circuit does not eliminate the carrier. It simply reduces its amplitude. A true balanced modulator completely eliminates the carrier and leaves only the two sidebands. The circuit in Fig. 2 is the balanced version of the one in the Range Gain transceiver. Let's see how it works before we return to Fig. 1.

This is a *push-push* balanced modulator. The rf carrier is fed to the grids in push-pull while the plates are connected in parallel. The audio (modulating) voltage is fed to the grids in parallel through the center tap on the grid tank coil. (The rf coil has negligible impedance at audio frequencies so we can consider the grids to be connected directly in parallel.)

When the carrier alone is fed to the circuit, the rf signals on the grids are equal and 180° out of phase. Since the plates are in parallel, the equal and opposite plate-current pulses cancel, and no carrier voltage appears in the output tank circuit.

When we apply audio alone, the plate-current pulses are equal and in phase, but no signal appears in the output because the tank circuit has nearly zero impedance at audio frequencies.

When carrier and modulating voltage are applied simultaneously, the audio and rf voltages add on one grid and subtract on the other. The circuit is unbalanced and two signals (sidebands) appear in the output. One equals the sum of the carrier and audio frequencies, and the other is the difference between them. The carrier has been cancelled out.

Back to Fig. 1. Rf is fed to the grids in push-pull and the plates feed the output circuit in parallel. Note that this circuit is unbalanced with B-plus being fed to V1-a's plate and V1-b's cathode. V1-a's cathode and V1-b's plate return to ground through the secondary of the modulation transformer.

When the rf carrier is fed to V1, V1-a conducts and delivers some carrier power to the load. V1-b is cut off because its cathode is positive with respect to the plate. Now, when we apply modulation, several hundred volts of audio is developed across the modulation transformer. V1-b conducts on positive modulation cycles and feeds the load with a modulated signal whose amplitude varies with the audio level. The relative carrier and sideband levels are determined by circuit design. Regency uses approximately 6 db of carrier suppression. Unmodulated carrier output is about 1.6 watts. Maximum undistorted power output (1,000-cycle tone) is around 4.5 watts.

Sideband power is now 2.9 watts as compared to 1 watt from an equivalent AM rig. This gain—a little more than 5 db—is not much, but it is often the difference between an unreadable signal and a readable one.

Sidewinder SSB-27

This is a five-channel filter type SSB CB transceiver made by Mark Products, Div. of Dynascan Corp. A switch on the panel selects the sideband to be transmitted and received. Its average dc power input is 5 watts. Peak envelope power (p.e.p.) is 10 watts. Carrier suppression is better than 30 db and the unwanted sideband is suppressed at least 40 db. Receiver bandwidth is 3 kc at 6 db down. The un-

Mark Products Div. of Dynascan) Sidewinder single-sideband CB transceiver.

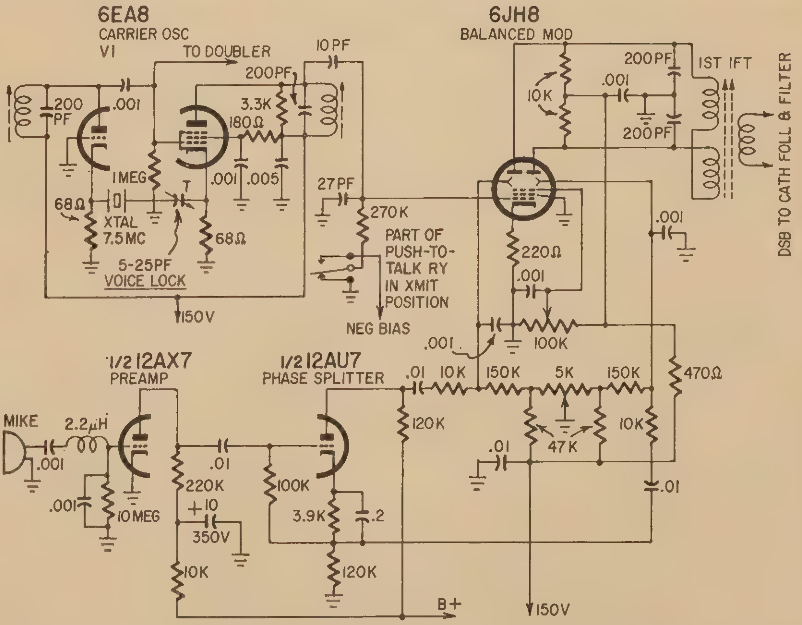

Fig. 3—Mark Products Sidewinder SSB-27 uses beam-switching tube as balanced modulator to produce DSB. One sideband is then attenuated, making SSB.

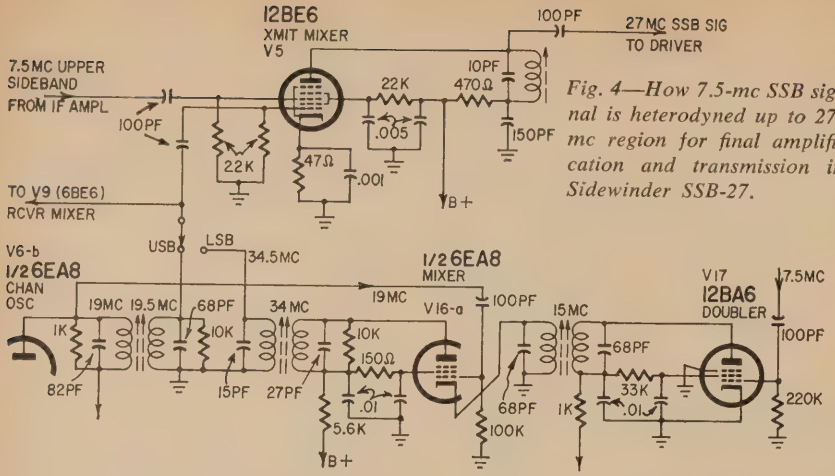

Fig. 4—How 7.5-mc SSB signal is heterodyned up to 27-mc region for final amplification and transmission in Sidewinder SSB-27.

wanted sideband is suppressed (in the receiver) a minimum of 40 db and adjacent channels (10 kc removed) are at least 60 db down.

The frequency generator, filter circuit and some of the i.f. amplifiers are common to the receiver and transmitter circuits. The "heart" of the transceiver is a 7.5-mc Butler crystal oscillator. It is the carrier generator for the transmitter. The receiver uses it as a source of one of the signals used to heterodyne the incoming signal down to the i.f. and for carrier reinsertion in the product detector.

Another balanced modulator

Fig. 3 shows the carrier oscillator, the beam-deflection type balanced modulator and the transmitter audio circuits. The 7.5-mc signal (carrier) goes to the control grid of the 6JH8 and push-pull audio goes to the deflection plates. The carrier is balanced out. The 7.5-mc double-sideband suppressed-carrier i.f. signal is fed through a cathode follower to a four-section crystal lattice filter that removes the *lower* sideband.

Following one stage of 7.5-mc i.f. amplification, the upper-sideband signal is fed to grid 3 of a 12BE6 mixer (V5 in Fig. 4). Grid 1 is fed an injection signal from the channel oscillator that determines which channel the set operates on. The channel oscillator uses a Butler circuit with five selectable crystals centered around 19.5 mc.

Sideband selection

When operating on upper sideband (USB), the 19.5-mc injection voltage and the 7.5-mc upper-sideband i.f. signal add to produce a 27-mc upper-sideband signal on the desired channel.

On lower sideband (LSB), a 34.5-mc injection frequency is used. This is generated by doubling the 7.5-mc output of the carrier oscillator and adding it to the 19.5-mc output of the channel oscillator. The 7.5-mc upper-sideband i.f. signal subtracted from 34.5 mc (in mixer V5) yields the 27-mc lower-sideband signal.

The 27-mc upper- or lower-sideband output of V5 is fed to a power amplifier circuit consisting of two 6BQ5 linear amplifiers in the driver and output circuits.

The receiver

A block diagram of the receiver is in Fig. 5. The incoming signal is amplified in V8, a 6CB6, and fed to grid 3 of V9, a 6BE6 mixer. Here it mixes with a 19.5- or 34.5-mc injection frequency to produce the 7.5-mc i.f. (The injection frequency used depends on whether the mode switch is set for USB or LSB. The 19.5- and 34.5-mc signals are generated in the frequency-control circuits, Fig. 4, common to the receiver and transmitter.)

The 7.5-mc output of V9 goes through the cathode follower and crystal sideband filter to a two-stage 7.5-mc i.f. amplifier. The cathode follower, crystal filter and first i.f. amplifier are common to the receiver and transmitter.

The amplified i.f. signal goes to detector V11, and the avc rectifier. The audio signal is recovered by beating the 7.5-mc i.f. sideband signal with the 7.5-mc CW signal from the carrier oscillator. The audio goes through a squelch diode to the af amplifiers. The avc rectifier controls the gain of rf amplifier V8, mixer V9 and the second 7.5-mc i.f. amplifier.

The carrier and channel oscillators in two SSB-27's in a CB system must be within 70 cycles or less of each other for best readability and crisp, natural reproduction. Otherwise, the voice will be either nasal or bassy. The VOICE LOCK control (a small trimmer capacitor in series with the 7.5-mc crystal) of the station called should be set for the most natural voice. Both units are then on exactly the same frequency and are held there by the thermostatically controlled crystal oven. END

The 6JH8 is a double-plate sheet-beam deflection tube designed for color-demodulator and burst-gate circuits in color TV sets. It has also been used in FM-stereo demultiplexers and, as here, in single-sideband transmitters. Its electrode structure consists of a cathode, three grids, two plates and two deflection plates or deflectors.

The total plate current is determined by the voltages on grids 1 and 3—the control and accelerator grids, respectively. The deflection plates act very much like those in an electrostatically deflected CR tube. When the voltages on the deflectors are equal, the cathode current divides equally between the two plates.

In balanced modulator service, the rf signal is fed to the control grid and push-pull audio is fed to the deflectors. If the carrier is applied with no audio on the deflectors, the plate currents are equal and in phase and the carrier cancels out in the plate circuit. When modulation is applied, the circuit is unbalanced and sideband voltages are developed across the tuned output circuit.

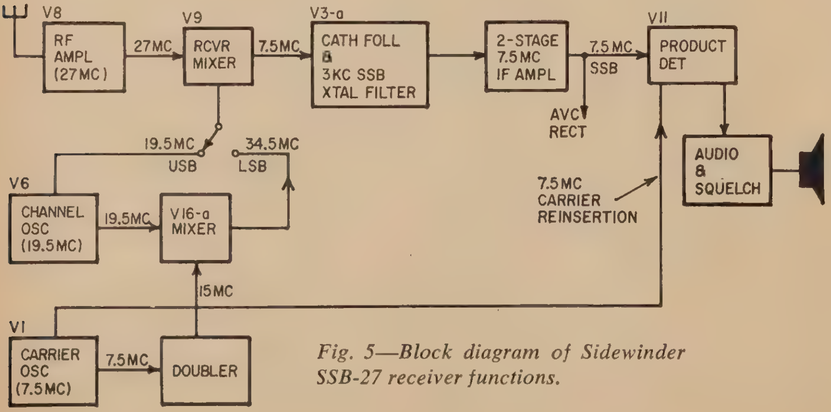

Fig. 5—Block diagram of Sidewinder SSB-27 receiver functions.

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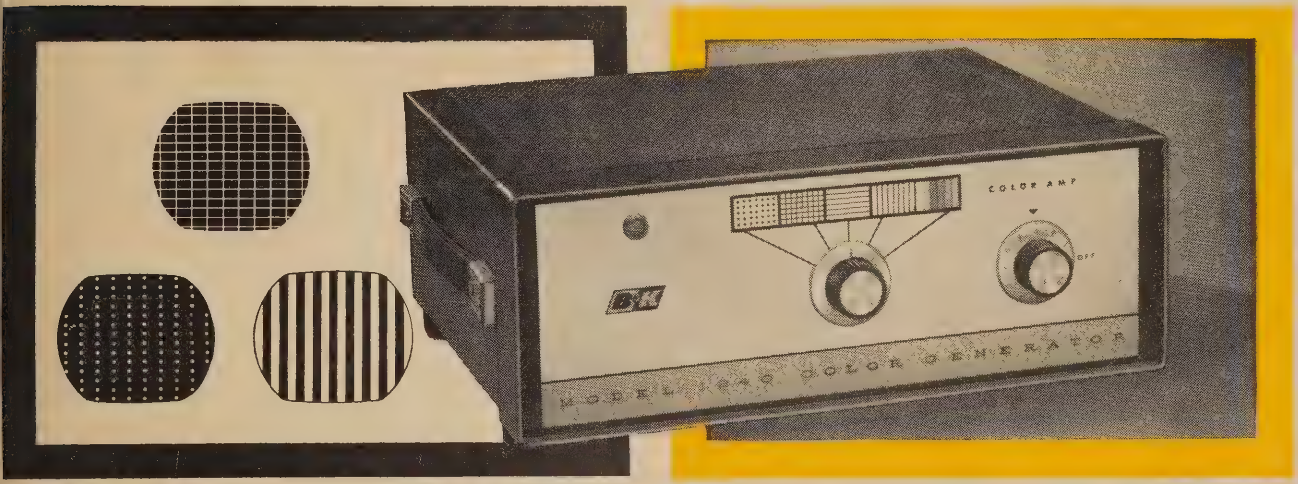

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(Just one raster scanning line thick)

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Provides crystal-controlled keyed rainbow color display on TV screen to test color sync circuits, range of hue control, and align color demodulators. Shows ability of TV receiver to display color values.

Provides dot pattern, crosshatch, horizontal and vertical lines. Highly stable crystal-controlled count circuit with small-step count assures greater reliability and stability of color, dots, and lines. All horizontal lines and dots are just one raster scanning line thick. Lines begin off-screen and end off-screen, with no break in line. Dot brightness is adjustable with easily accessible control. Chroma Level Control simplifies color sync trouble-shooting.

Operates on channels 3, 4, and 5, and adjustable without removing cabinet. No connection inside TV set is needed. Power transformer operated and line isolated to prevent shock hazards. Operates reliably on 105-125 VAC, 60 cps. (Color Gun Killer is available as optional accessory.) Extreme lightness and portability (9 lbs.) make it ideal for in-home servicing.

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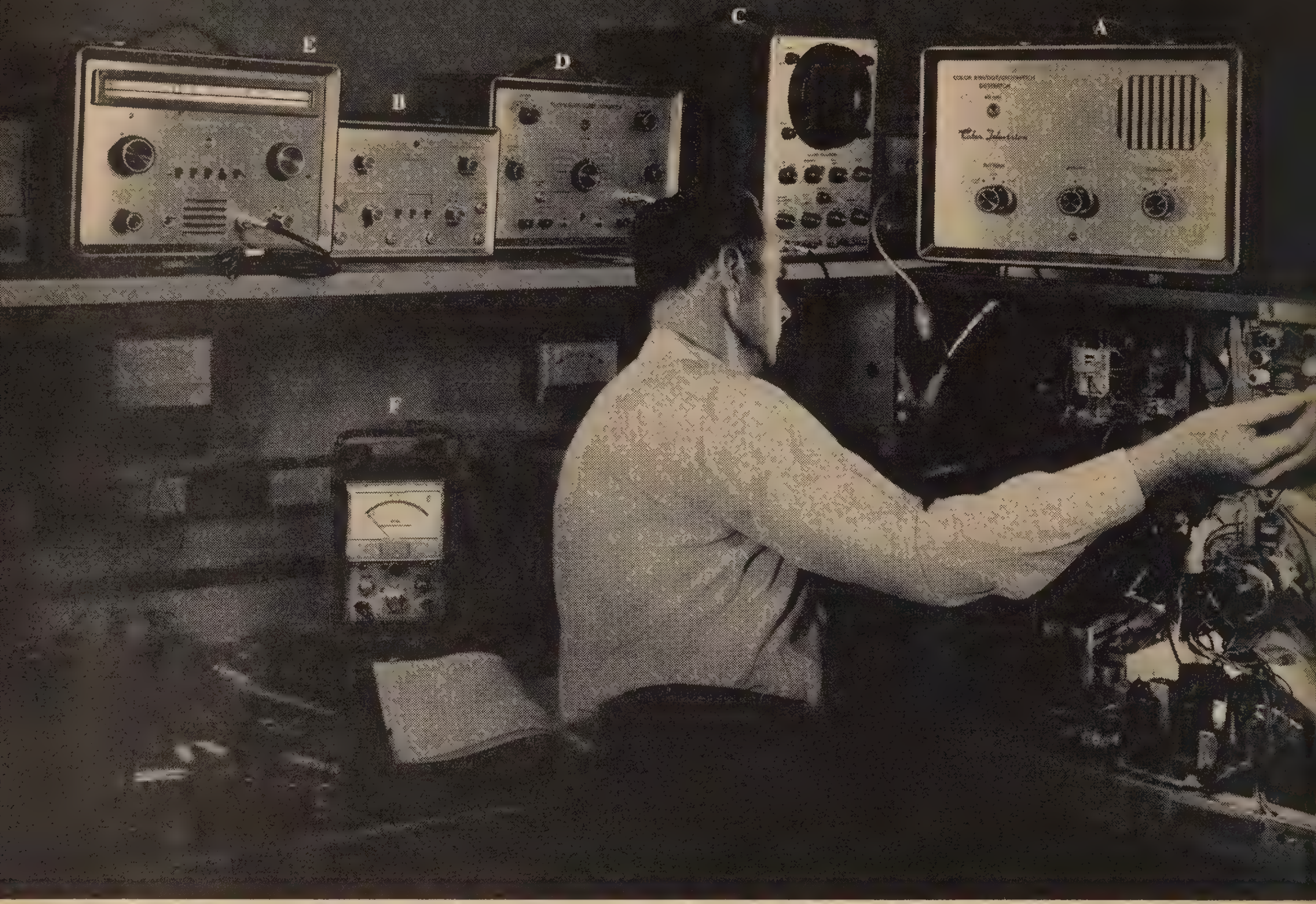

Making last-minute convergence adjustments on a color-TV receiver with an RCA WR-64A Color-Bar/Dot/Crosshatch Generator.

(A) RCA WR-64A COLOR-BAR/DOT/CROSSHATCH GENERATOR

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A wideband scope for checking colorburst signals and general troubleshooting.

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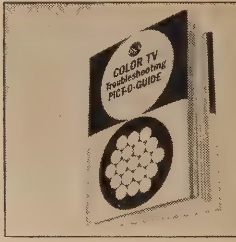

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The color TV signal

LET'S CLEAR UP A FEW THINGS ABOUT the color TV signal, in short words. What's a "color subcarrier," and why "3.58 mc"? How is it transmitted?

A black-and-white TV signal is an AM picture signal and an FM sound signal, on the TV station carrier (Fig. 1). If this is channel 2, the carrier frequencies would be as shown—sound 4.5 mc higher than the picture. Actually, the sound could just as well be 4.5 mc *below* the picture. It is, when we get to the receiver's i.f. stages!

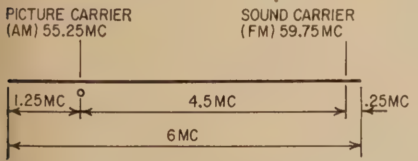

Fig. 1—Black-and-white TV signal on channel 2.

A color signal begins as three AM signals (from the cameras). These are combined in the familiar 30% red, 59% green and 11% blue ratio to make the brightness signal (100%). Now we've got to get this onto the carrier without interfering with what's already there. So we modulate it onto a *subcarrier* to make it a higher frequency. Also, since we've already used up AM and FM, we use *phase modulation* (PM). The color information is converted into PM values of the sidebands of a 3.58-mc carrier. To save postage (and interference!), we take out (suppress) the 3.58-mc carrier and send only the sidebands.

We send *two* signals, not three. To keep them from mixing, we leave one in-phase with the carrier (I) and throw one 90° out of phase with it, or in "Quadrature" (Q). (This is the "ideal" approach; in modern sets the signals—always at right angles to each other—may not be exactly in line with and at 90° to the carrier. So we read about R − Y and B − Y, or X and Z, instead of I and Q signals.) These are the upper and lower sidebands, centered around where the carrier would have been. Now our TV channel looks like Fig. 2, still on channel 2. The picture carrier is still the reference point, with the color sidebands 3.58 mc above it and the sound 4.5 mc above it. This whole mess is now pumped up the transmission line and sprayed over the countryside.

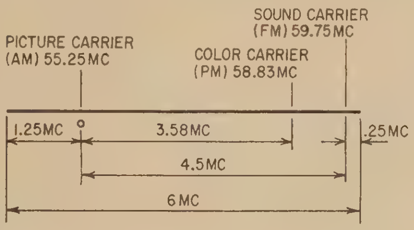

Fig. 2—Same TV carriers with color subcarrier added—or at least where the color subcarrier would be if it were transmitted. Actually only the sidebands go along.

Why 3.58 mc? Well, we're adding a lot of extra stuff to the already crowded TV channel. Engineers discovered that the energy wasn't evenly distributed over the whole channel, but concentrated in small bunches. So they picked a color subcarrier that is an odd harmonic of the horizontal scanning frequency. This makes the color signals fall into holes *between* the bunches. On black-and-white receivers, the color signals cancel out on alternate scans of the raster, and all we see is the video or brightness signal. The result is compatible color—it can be viewed directly as black-and-white.

When we get to the TV receiver, all this is amplified, converted to an i.f., amplified again and fed to the video de-

continued on page 66

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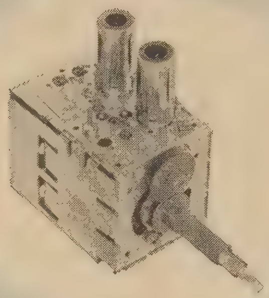

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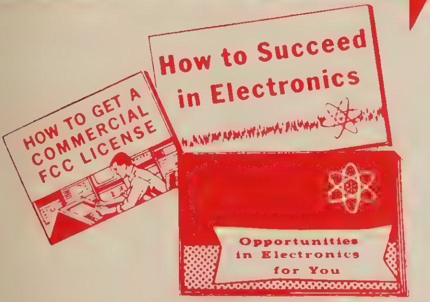
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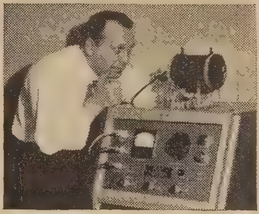

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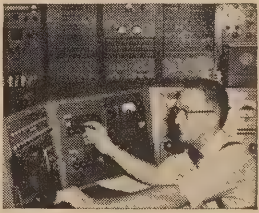

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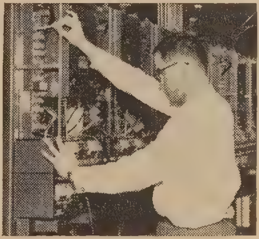

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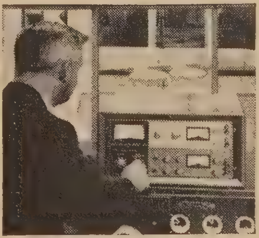

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Dept. RE-99, 1776 E. 17th St., Cleveland 14, Ohio tector. There, after detection (or demodulation), we find the picture signal as AM, and the 4.5-mc sound i.f. signal, which appears for the first time (it's a beat between the picture and sound carriers). Also, we recover the color signals, as a group of frequencies centering around 3.58 mc. These go to an amplifier stage tuned to accept only these frequencies, the sidebands of the original color carrier. That is where we get the name *bandpass amplifier*.

We left the color carrier behind at the transmitter, but we tore off little samples or "bursts" and sent them, sitting on the back porch of the horizontal sync pulses. Now we take these samples, use them to synchronize the receiver's crystal oscillator at 3.58 mc, and we have our color carrier back again, in phase with the one at the station.

We sent only two of the three color signals. But we have the whole, or sum, in the brightness signal, which is 30% red, 59% green and 11% blue (= one). Since we have two of these fractions, we can add them, then subtract the result from the "whole", and we have the missing signal! Sounds complex, but it isn't. Look at the color amplifier circuits of the CTC16. Three triodes, with their cathodes tied together, have separate inputs to the grids, while the plates go to their individual guns in the color CRT.

These tubes do the "matrixing", which simply means "adding and subtracting," and the result is the same three color signals we started out with back at the transmitter!

No matter what we do to this signal along the way—change its frequency, etc.—we'll still wind up with the same results when we get to the receiver, as long as we don't change the signal's relationship to the picture carrier, and we can't do that.

Displaced picture elements

A Sparton 5301 produces a perfect picture at low contrast levels. When the contrast is advanced, the bright elements of the picture are displaced downward about ⅛ inch from the rest of the lines. Some of the video signal seems to be getting into the vertical sawtooth. The set was not in use for the past couple of years—M. I. S., New York, N. Y.

From the description and also from the fact that the set was idle for over 2 years, I'd say the most likely place to look would be around some of the electrolytics. During an idle period of that length, one of them may have dried out, and is now allowing video peaks (which would correspond to bright elements in the picture) to leak into the horizontal deflection scanning lines. Notice the similarity between this symptom and a case of true yoke ringing—the tell-tale symptom of yoke ringing is always a vertical deflection of the scanning lines.

Without a scope, your best bet would be to bridge the electrolytic capacitors, one at a time, with a new unit of about the same capacitance (and voltage rating). If you can get up early enough to use a test pattern, this would make it somewhat easier. However, when you find the bad one, it will probably be obvious enough. Use an ac voltmeter or scope to check the B-plus lines for excessive ripple. (Use the meter with a blocking capacitor.) Check all suspected lines and if you find one with what could be too much ripple, take the antenna off and measure again. If the ripple drops quite a bit, you're home free. Also, leaving the meter connected, bridge the capacitor and see if the ripple goes away down, as it should.

Conversion to German TV standards

I'm stationed in West Germany. A lot of us have old US TV sets; they'll pick up the picture on the German TV networks, but no sound. Can they be converted?—A. N., APO, New York

continued on page 70

A NEW CONCEPT IN COLOR TV ANALYZING PUTS YOU IN THE *PROFITABLE* COLOR TV SERVICE PICTURE AT A VERY LOW COST

Model 900
COLOR TV
ANALYZER

Color TV set sales are booming all over the country! To help progressive servicemen get their share of the color service business Mercury has developed a highly efficient instrument based on an ingenious new engineering concept in color TV analyzing. The Model 900 Color TV Analyzer enables you to tackle color TV servicing in the home and in the shop with ease and confidence at a minimum cost.

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NEW

Makes all tests dynamically while color set is in operation

Exclusive circuit eliminates need of range switches. Just set element selector and meter is automatically on right range

Connects as easily as a picture tube brightener...no need to get under TV chassis

Safety feature...circuit allows safe measurement up to 7000 volts on focus grid

MAKE ANY ONE OF THESE TESTS IN MINUTES

● TEST each control grid voltage... indicates shorts or gas in each color gun ● TEST each color gun screen voltage and screen current...indicates trouble in power supply or boost circuits ● TEST focus voltage...indicates high voltage or horizontal deflection circuit trouble ● TEST each cathode voltage...indicates circuit trouble ● TEST each control grid emission current...indicates shorts or gas in each color gun ● TEST each color gun cathode emission...indicates dynamic quality of each color gun.

The Model 900 enables you to cut-out color guns in any combination and adjust for proper PURITY —CONVERGENCE—and GRAY SCALE TRACKING.

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EUROPIUM RED, developed at GT&E Laboratories, is the brightest red known to the industry. And, to match it, now the full brightness of blue and green is used. The result is a color picture tube that gives the entire television industry a boost.

Because the COLOR BRIGHT 85 tube is *really* bright, dealers can demonstrate color TV effectively in normally lighted showrooms. As the set's brightness is adjusted, the colors remain true—not shifting to unnatural tones in the highlights of the picture.

Another thing, black and white performance is far better than you've ever seen before in a color tube. Besides the increased brightness, there's improved contrast in a sharp, vivid picture.

The new, exciting COLOR BRIGHT 85 picture tube is a product plus from Sylvania for the entire color television industry, and particularly for dealers. In color, as in black and white, you know it's good business to handle the Sylvania line.

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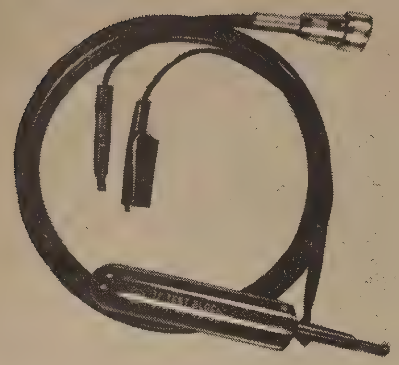
*Tests show the COLOR BRIGHT 85 tube is 43% brighter, on the average, than standard color picture tubes.



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Bandpass analysis should be part of your regular service technique—pinpoint faulty circuits accurately and rapidly with these five alignment aids:

Video Detector Test Block—8B105
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For all RCA TV receivers and most other makes of color TV receivers.

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Extends yoke cable when any RCA Victor color chassis is removed from cabinet for servicing.

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Extends kinescope high voltage lead when 212 Series color chassis is removed. 13A100.

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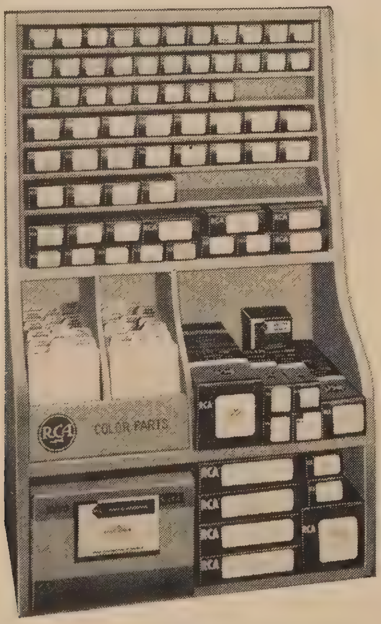

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It used to take 2 men to pull a color TV set into the shop...
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Cuts your manhours on Color-TV home service calls

Here is a real "must" for anyone servicing or planning to service color TV sets.

No longer must you send two men to a customer's home to pull in his entire color set. Now, one man can simply remove the chassis and bring it back to your shop for testing, troubleshooting and alignment in your RCA Color TV Test Jig.

Look at some of the extra advantages built into this money-saving unit:

- **Minimizes costly damage claims**. Pulling chassis eliminates possibility of scratching or damaging a customer's cabinet when transporting it to and from his home.
- **Saves time.** Eliminates need to reconverge a customer's set when chassis is returned. Convergence control panel on Test Jig provides static and dynamic convergence.
- **Versatile.** Can be used with all RCA color chassis.
- **Safe.** Supplied with factory-installed safety glass and kine mask.
- **Complete components kit,** supplied with unit, provides all necessary service components and instructions for installing RCA Color Picture Tube.
- **Professional appearance.** Finish matches that of your other RCA test instruments.

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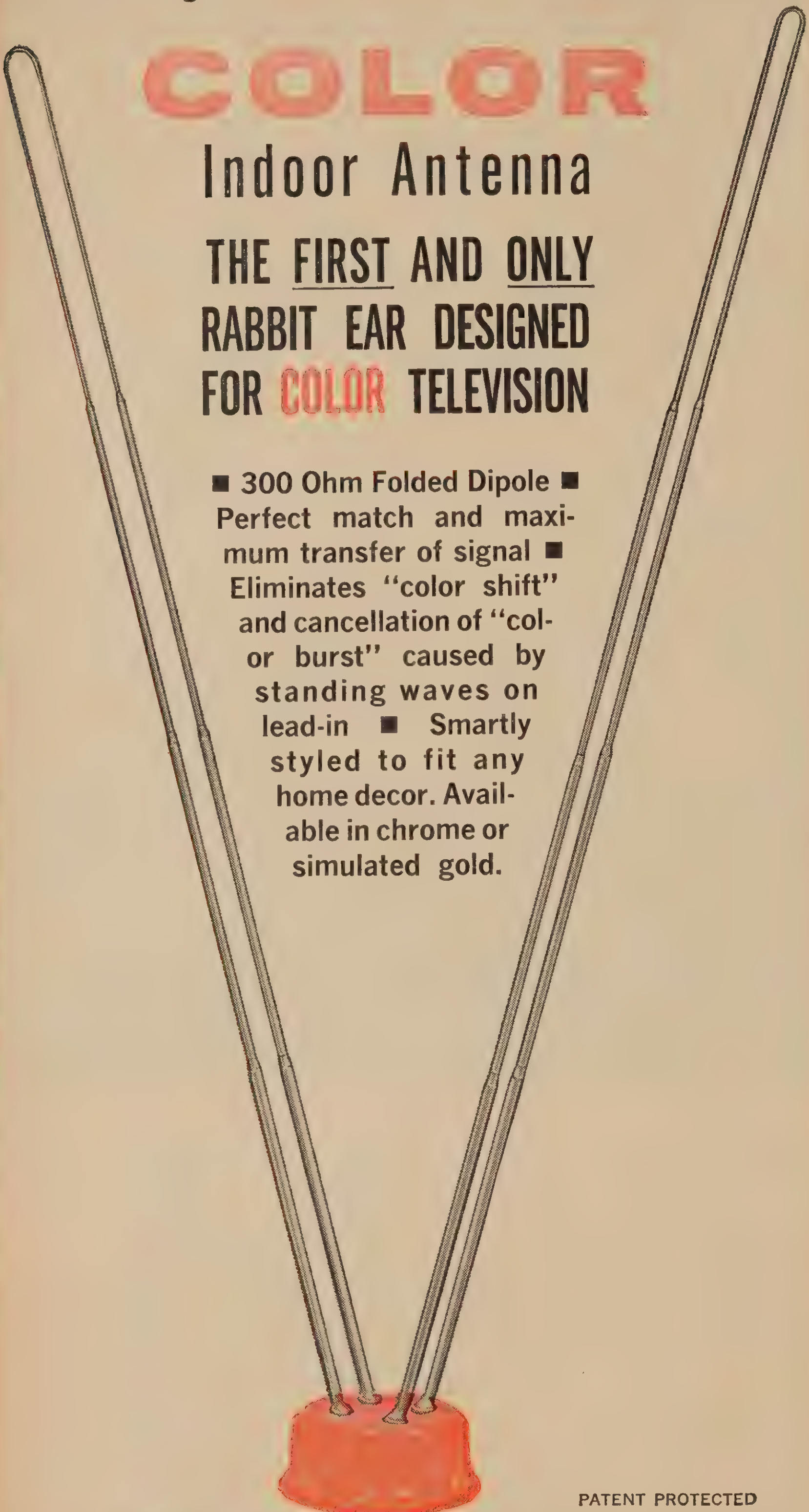

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Should be possible. The West German TV broadcast system uses the CCIR system, which is near enough to our channel frequencies so that you're getting the pictures. However, their sound is 5.5 mc away from the picture! Sets built to US standards have 4.5-mc separation and won't get the sound properly.

In some cases, your present sound i.f. stages *might* be retunable. However, I don't think so. Get a set of European sound i.f. and discriminator or ratio detector transformers and install them instead. This ought to be a fairly simple conversion. You'll have to get the transformers there; I can't find a suitable transformer listed in any of our catalogs. We just don't use 5.5-mc transformers for anything!

The table shows the differences between the US and CCIR standards. Note the difference in total lines: this makes the horizontal sweep different, too, of course, but most sets will adjust to it by changing the horizontal oscillator setting.

	US	CCIR
Video bandwidth	4 mc	5 mc
Channel width	6 mc	7 mc
Sound-to-pix spacing	4.5 mc	5.5 mc
Line freq. (horizontal)	15.750 kc	15.625 kc
Frame freq. (vertical)	60 cycles	50 cycles
Video modulation polarity	negative	negative
Sound modulation	FM	FM
Deviation of sound carrier	±25 kc	±50 kc

Remote control in Philco H-4251R

I have a remote-control Philco TV; the remote is wired in. It won't work in REMOTE *position, although it's OK in* MANUAL.*—W.W., Pasadena, Calif.*

Someone has modified this set. The original remote is an ultrasonic type! Check the remote-control wiring; service data are in Sams 479-1, including the RC-50 remote. Your on–off switch must be on for the remote to work. The ac line circuit goes through a bistable relay in the RC-50 chassis (Fig. 3).

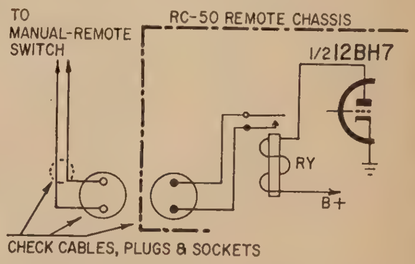
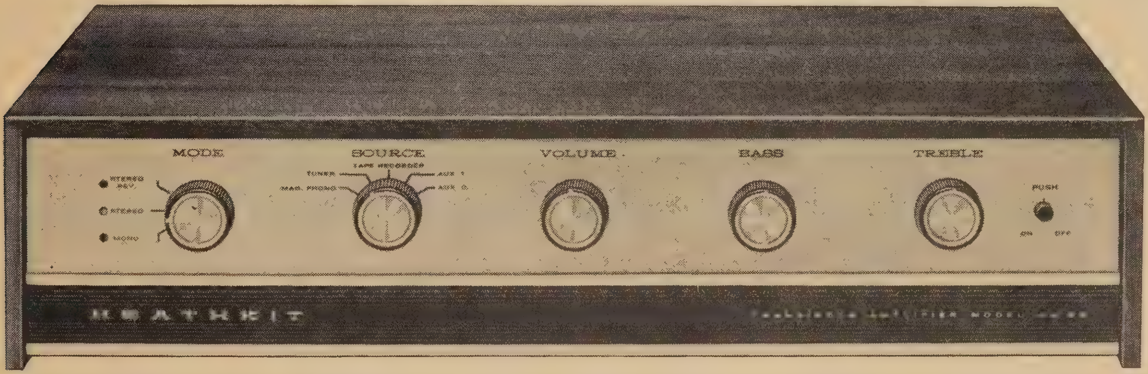


Fig. 3—Remote-chassis relay must be closed before set can work in REMOTE *position. Also, on-off switch of set must be closed before remote unit can work!*

Check the 12BH7 in the remote chassis, and the connections to the relay. Also clean the relay contacts. END

"Until just recently, I have been somewhat skeptical about low priced transistor amplifiers. However, after testing and listening to the Heath AA-22, I feel it is time to revise my opinion. This remarkable amplifier can easily hold its own against any amplifier—tube or transistor—anywhere near its price range."

JULIAN D. HIRSCH, Hi Fi/Stereo Review, Nov. '64



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Let's Look Closer! The AA-22 provides 40 watts continuous, 66 watts IHF music power at ±1 db from 15 to 30,000 cps. Features 5 stereo inputs to handle mag. phono, stereo-mono tuners, tape recorders, & 2 auxiliary sources. There are 4, 8 & 16 ohm speaker outputs plus tape recorder outputs; a 5-position selector switch; 3 position mode switch; dual-tandem control; bass & treble controls.

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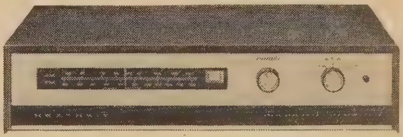

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The above quote comes from July '64 issue of *Radio-Electronics*.

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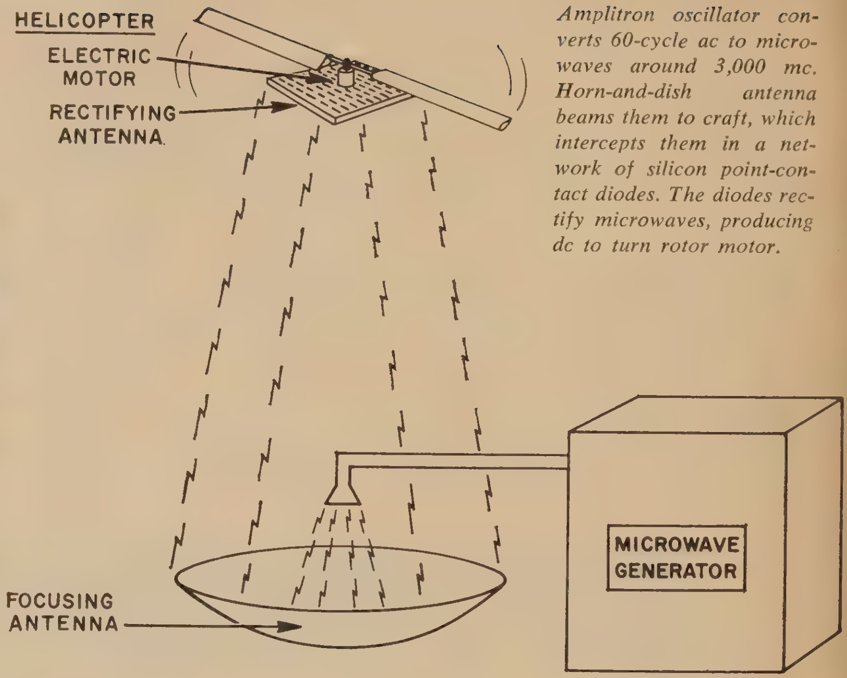


Amplitron oscillator converts 60-cycle ac to microwaves around 3,000 mc. Horn-and-dish antenna beams them to craft, which intercepts them in a network of silicon point-contact diodes. The diodes rectify microwaves, producing dc to turn rotor motor.

At Last—Wireless Power Transmission

10-CM MICROWAVES HOLD FUEL-LESS, CONTROL-LESS MODEL HELICOPTER 50 FEET ABOVE THE GROUND

By **PETER E. SUTHEIM**

ASSOCIATE EDITOR

A HELICOPTER WITH A 6-FOOT ROTOR, powered only by microwave energy beamed from the ground, climbed 50 feet into the air in the first public demonstration of microwave motive power.

The showing, held at the Raytheon Co.'s Spencer Laboratory in Burlington, Mass., was called a "progress report" to visiting officials from the US Air Force's Rome Air Development Center in Rome, N.Y., which had commissioned Raytheon to develop the device.

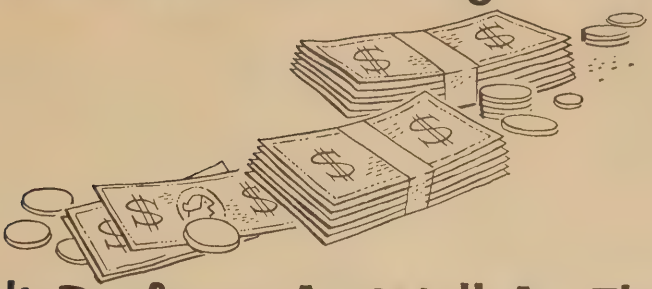
Five kilowatts of microwave energy in the 10-cm wavelength region (about 3,000 mc) was beamed vertically upward from a parabolic dish antenna on the ground, and intercepted by the helicopter. The body of the copter is a grid of thousands of tiny rectifying diodes, looking like a glass-beaded blanket, which intercepts the microwaves and rectifies them directly to power a $\frac{1}{5}$-hp dc motor. The motor drives the twin-blade rotor through gears.

In the Spencer Labs demonstration, the helicopter was tethered to vertical guy wires to keep it centered directly over the beam. A practical load-carrying craft, though, would be equipped with "beam-riding" servomechanisms to keep it in the force field.

Transmitting motive power without mechanical or electrical connections is an idea more than half a century old. The name that comes to mind almost immediately is Nikola Tesla, whose experiments in 1899 with the high-power coils named for him are part of radio legend. But real progress was held up by the tremendous waste in radiating enough energy in all directions so that a device could intercept enough to power itself. Clearly the answer was to use shorter wavelengths, which could be beamed by directional antenna arrays, or with quasi-optical devices.

Until World War II, however, there was no way of generating more than a few microwatts of energy in the centimeter-wavelength region. Not until the velocity-modulated beam tube (later, the klystron), developed just before and

Regardless Of What You Pay For Other Color TV



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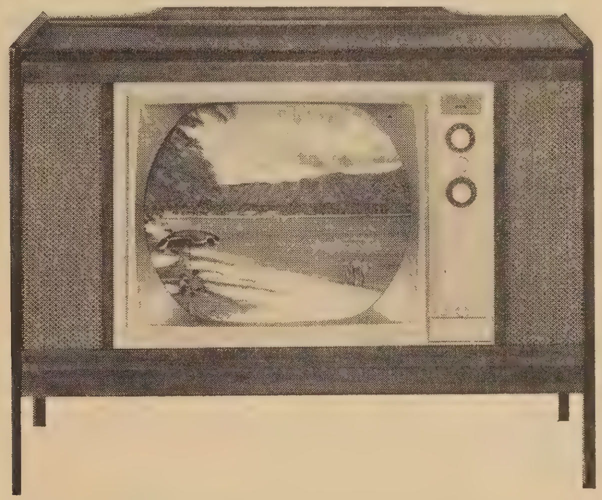

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See the special articles on the Heathkit GR-53A in the May issue of *Popular Electronics*, June issue of *Radio-TV Experimenter*, February issue of *Popular Mechanics*, April issue of *Science & Mechanics*, and the August issue of *Radio-Electronics!*

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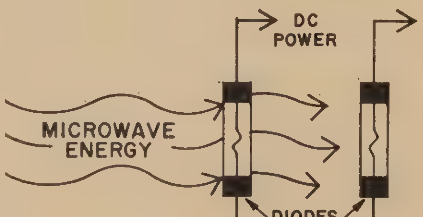
Readying the microwave helicopter for its tethered flight is Wiliam C. Brown, manager of Raytheon's Super Power Lab. Rectangular array supports diodes.

during World War II, could engineers experiment with high-power microwaves.

Toward the end of 1962, such a tube was made to generate more than 400 *kilowatts* of continuous power at 10 cm, with an efficiency of better than 70%. In 1964, a klystron developed at the Eitel-McCullough Co. generated 200 kw continuously at 3.6 cm. That kind of power removed the first major obstacle to long-distance wireless power transmission.

The next problem was how to convert the intercepted microwave energy into energy that could do mechanical work. Early experimenters suggested turning the microwave energy into heat, which would be used to run a gas turbine of some kind. But the overall efficiency of that process is poor—not over 25% at best. The best way seemed to be to transform the microwaves directly into dc or low-frequency ac. Efficiency—at least theoretically—promised to be much better that way. Arrays of silicon point-contact diodes, assembled in a waveguide, worked fairly well, but were too heavy for airborne work.



Silicon diodes themselves are antenna and rectifiers. They are interconnected in series-parallel aiding, and, in the model demonstrated, produced a total of some 200 watts of dc for the motor.

The first experiments at Raytheon used a close-spaced thermionic diode (cousin of the ordinary hot-cathode rectifier) to deliver up to 900 watts at 50% efficiency from a package that weighed less than 2 pounds.

On May 23, 1963, Raytheon's Spencer Laboratory demonstrated a system that worked at 2,450 mc with 400 watts of generated power. This was focused into a narrow beam by an ellipsoidal dish 9½ feet in diameter, was transmitted 22 feet and captured in a receiving antenna. The received microwaves were rectified to produce 102 watts of dc, which was used to drive an electric motor.

Ultimately, Raytheon engineers developed the combined antenna–rectifier shown in the photograph and drawings, and it was that device that was used in the helicopter demonstration.

What can be done with it?

According to William C. Brown, manager of Raytheon's Super Power Laboratory and head of the development team for this project (dubbed *RAMP* for *R*aytheon *A*irborne *M*icrowave *P*latform), the flying platform might well be the beginning of a whole new line of craft that could be used for television transmission, missile detection, aviation beacons, navigational and weather aids, and surveillance.

Brown said that more sophisticated versions could be fully automated and keep themselves continuously in the path of the microwave beam at several thousand feet up. A new Amplitron tube that can generate nearly 500 kw could keep a helicopter aloft indefinitely at altitudes up to 50,000 feet. A payload capability of 50% seems feasible—that is, a microwave craft could carry its own weight in instrumentation or whatever other load someone cared to put aboard it.

Brown emphasized that the Air Force is *not* planning to fly conventional helicopters by this new means. Nor are significant space applications expected, he said, because solar-cell power is more practical outside the atmosphere, where weight is less of a problem.

The new propulsion system has started some amusing speculations. Microwaves have long been used to produce deep internal heat in living tissue (as in diathermy). It's just possible that transmitting dishes for airborne microwave platforms might be surrounded with flocks of migrating birds that stopped by to warm up on their way south. END

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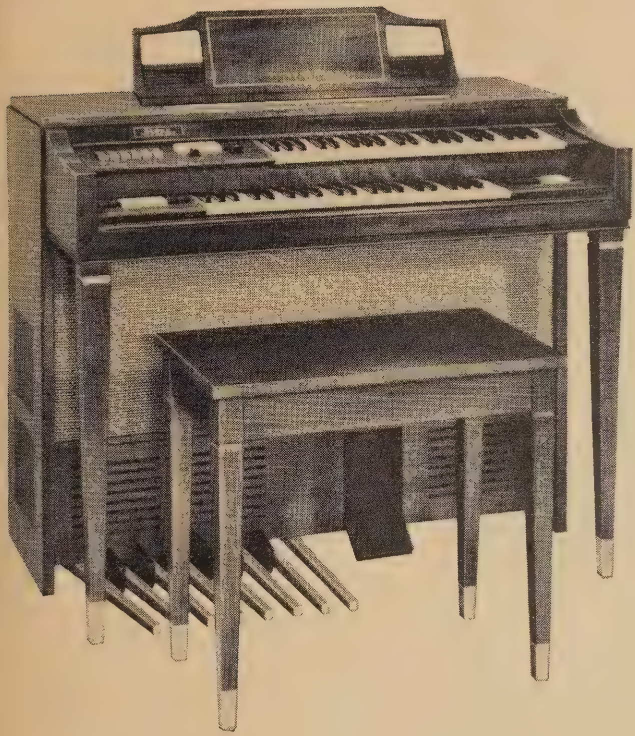

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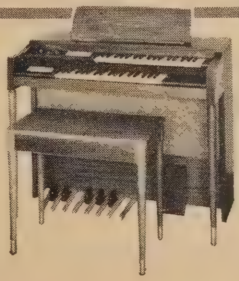

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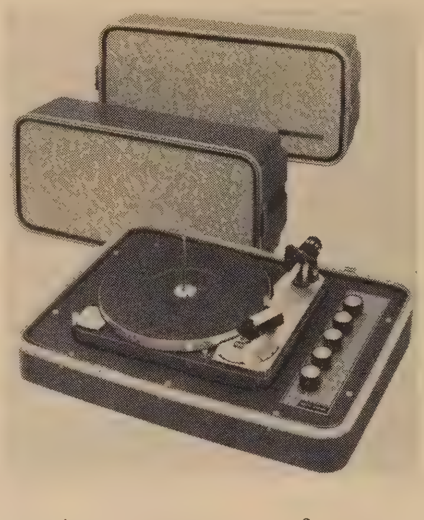
AUDIO EQUIPMENT REPORT

Shure M100L Portative System



WHAT'S A PORTATIVE SYSTEM? AND THAT promotion, *"perfectionism is not inexpensive, ever!"* I never did like double negatives. But I must admit that here the positive equivalent just wouldn't do. Many manufacturers have sold merchandise by stuffing in lots of parts and charging a high price, but I would not call their products perfectionist! So how else can one say this is as good as you can buy for any money? And Shure has good basis here to make such a claim.

The specifications read very well, and measurements show they are for real. But listening is the true test, and that you'll have to do for yourself to believe. I know of only one system that, to my ears, sounds just perceptibly better, and that's made up of components that total some five times the cost of this Shure system. And when others made the same comparison, not all of them could agree with me that there was any detectable difference in quality at all.

The difference certainly was not in cleanness or in wideness of band. In these qualities, the Shure system is without peer; the very, very slight difference I could detect was in smoothness of response. Yet with this system, I was amazed at the sense of presence, particularly on good recordings. It was difficult to believe, with my eyes *open,* that the performers were not actually there. It just did not sound a bit like reproduction. It had to be the real thing.

The wonderful thing is that this performance can be picked up in moments and taken round to a friend's house, or wherever you want to take it. It's built the same way as Samsonite luggage and even has Samsonite luggage keys. There are two carrying units: the player, and the speakers, which lock together face to face. One of the small details I appreciate is the way the detachable hinges on the player lid have one pin longer than the other. Have you ever fussed with getting these hinges together again, when both pins are the same length? This problem is completely solved.

I can't say more about the performance: that you must hear for yourself. But they seem to have thought of almost everything in the mechanics of making the system "portative": an automatic clamp to hold the heavy turntable in position on short trips; a place to park the manual and automatic spindles and the 45-rpm center piece; the Dual changer features—simple screw locks for securing the table against too-vigorous transportation treatment, and a simple but effective tonearm lock. The one thing the system could use, for making transportation and setup slightly simpler, would be more specific provision for storing the connecting cords: they come in a plastic bag, which has no definite place.

Packaging and instructions for assembly, as the machine comes from the factory, are excellent. The secret of the superb phonograph performance is in the teaming up of the Dual changer, which allows tracking at ½ gram, with the Shure stereo cartridge, which gives such clean high-end and good separation. One thing I noticed about playing at ½ gram: the arm is dynamically balanced (when correctly adjusted) against being unlevel, or against vibration through floor or table. But it's not balanced against the wind blowing, if you use it outdoors in a windy location! An extra gram or so, which is still less pressure than most changers apply normally, will hold this against anything but a hurricane; and who plays records outdoors during a hurricane?—*Norman Crowhurst.*

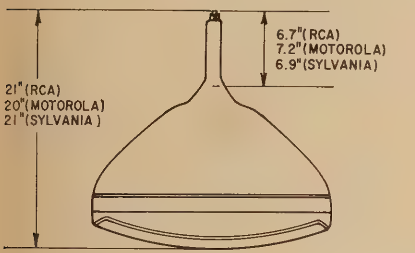
MANUFACTURER'S SPECIFICATIONS

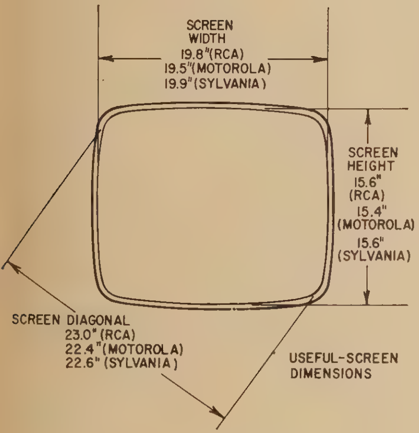
Amplifier response: ±2 db, 30 to 20,000 cycles (at 12 watts into 8 ohms, tone controls flat)
Maximum continuous power: 50 watts, both channels operating simultaneously (30 watts with only one channel operating)
Harmonic distortion: less than 1% from 30 to 15,000 cycles (at 1 watt into 8 ohms)
Intermodulation distortion: less than 3% at 12 watts, using 400 and 4,000 cycles mixed in 10-to-1 ratio
Speaker distortion (harmonic): 2% from 200 to 15,000 cycles; 4% from 100 to 200 cycles at 12 watts electrical input
Price: about $400

New Semiconductors and Tubes

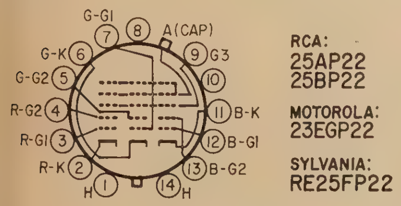
THE COLOR RECTANGULARS

1964 brought us the first color picture tubes with rectangular faceplates: the 25AP22 and 25BP22 from RCA; the 23EGP22 from Motorola, made by National Video Corp.; Sylvania's RE25-FP22; and a 25-inch rectangular from Zenith's subsidiary, the Rauland Corp.





The "square corner" shape became immensely popular when it was introduced for black-and-white TV some 15 years ago. The effective picture area of a given overall faceplate size is considerably greater in rectangular tubes compared to round ones; or, in other words, the same size picture can be got from a smaller tube.



The hitch has been that while changing from round to rectangular black-and-white tubes involved chiefly working the bugs out of a new bulb shape, the same change in color meant a whole series of complex changes, brought about by the greater intricacy of the color tube.

Here are the principal electrical and mechanical specifications of the RCA, Motorola and Sylvania tubes.

RCA 25AP22, 25BP22

(The two types are identical except that the 25AP22 has an integral protective window sealed to the faceplate, while the 25BP22 does not.)

Deflection: magnetic, 90°
Focusing: electrostatic
Convergence: magnetic
Picture area: 295 sq in.
Anode voltage: 27.5 kv max, 20 kv min
Heater: 6.3 volts, 0.8 ampere
Screen: aluminized, tricolor phosphor dot

Motorola 23EGP22

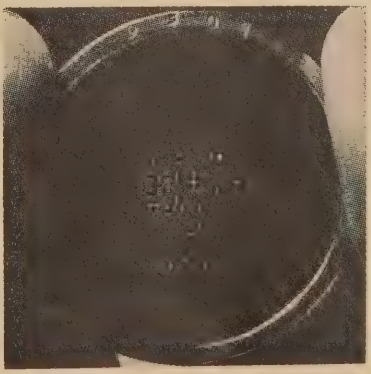
Deflection: magnetic, 92°
Focusing: electrostatic
Convergence: magnetic
Picture area: 282 sq in. approx
Anode voltage: 27.5 kv max, 20 kv min.
Heater: 6.3 volts, 1.35 amperes
Screen. aluminized, tricolor phosphor dot

Sylvania RE25FP22

Deflection: magnetic, 90°
Focusing: electrostatic
Convergence: magnetic
Picture area: 300 sq. in.
Anode voltage: 27.5 kv max, 20 kv min
Heater: 6.3 volts, 1.3 ampere
Screen: aluminized, tricolor phosphor dot

RCA has also announced plans to make small quantities of a new 19-inch 90°-deflection rectangular color picture tube available during the second quarter of 1965. The 19-inchers will be priced about $10 higher than the present standard 21-inch 70° round color tube, which now costs $98 with laminated safety faceplate, or $89.50 without.

Minimum screen area of the 19-inch tubes is 180 square inches. They are about 7 inches shorter than the current 21-inch round tube, and about 3 inches shorter than the new 25-inch rectangulars. Deflecting and converging devices for the 19-inch tube are the same ones designed for the 25-inch tube. More complete specifications, as well as specs on the Zenith color tube, will be printed as soon as available.



CHARACTRON COMPUTER DISPLAY

An improved computer readout device—a "shaped-beam tube," has been

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Desk RE-15C, 9500 W.Reno, Okla. City ,Okla.

announced by Stromberg-Carlson, a division of General Dynamics Corp.

The new tube is basically a cathode-ray device in which the beam from an electron gun is forced through a tiny matrix disc that carries 96 "holes" in the form of characters—upper- and lower-case letters, punctuation, mathematical symbols, selected Greek characters, etc.

The beam, shaped after being deflected into a particular "hole", strikes a phosphor-coated screen and produces a very-high-resolution image of the "hole" or character.

Earlier shaped-beam tubes had 64-character matrices, and all alphabetic characters were upper-case (capitals). Symbols on the face of the tube (named the Charactron) are typically repeated at a 30-per-second flicker-free rate.

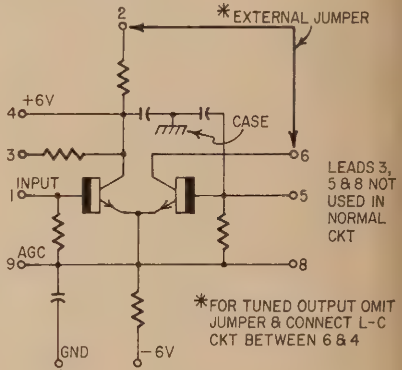
The Charactrons are being used in new computer display systems as well as in consoles for the National Aeronautics & Space Administration's Mission Control Center at Houston, Tex.

STABISTORS

Semiconductors with sharp *forward* breakdown characteristics at low voltages promise to have many uses as low-voltage regulators and stabilizers. Zener, or reverse-breakdown, diodes are seldom available for voltages less than about 3. The *stabistors* come in basic junction breakdown voltages of 0.4 and 0.7, at currents up to 25 amperes, combined in series for higher voltages. Reverse leakage current is mere microamperes.

These stabistors, made by P. R. Mallory & Co., have negative temperature coefficients and a working temperature range of − 35 to + 65°C. Experimental types are being supplied in epoxy-sealed stud-mount hexagonal packages with an integral heat-sink base.

One promising application is overvoltage protection of secondary (storage) batteries during charging. Connecting a suitable stabistor across each series cell provides a shunt path for current in case the charging voltage rises too high, threatening to damage the cell. Since such cells usually have terminal voltages of 2 or less, ordinary Zener diodes are not usable.


2
*EXTERNAL JUMPER
+6V
4
CASE
3
6
INPUT
1
5
LEADS 3, 5 & 8 NOT USED IN NORMAL CKT
AGC
9
8
*FOR TUNED OUTPUT OMIT JUMPER & CONNECT L-C CKT BETWEEN 6 & 4
GND
10
−6V
7

MC1936

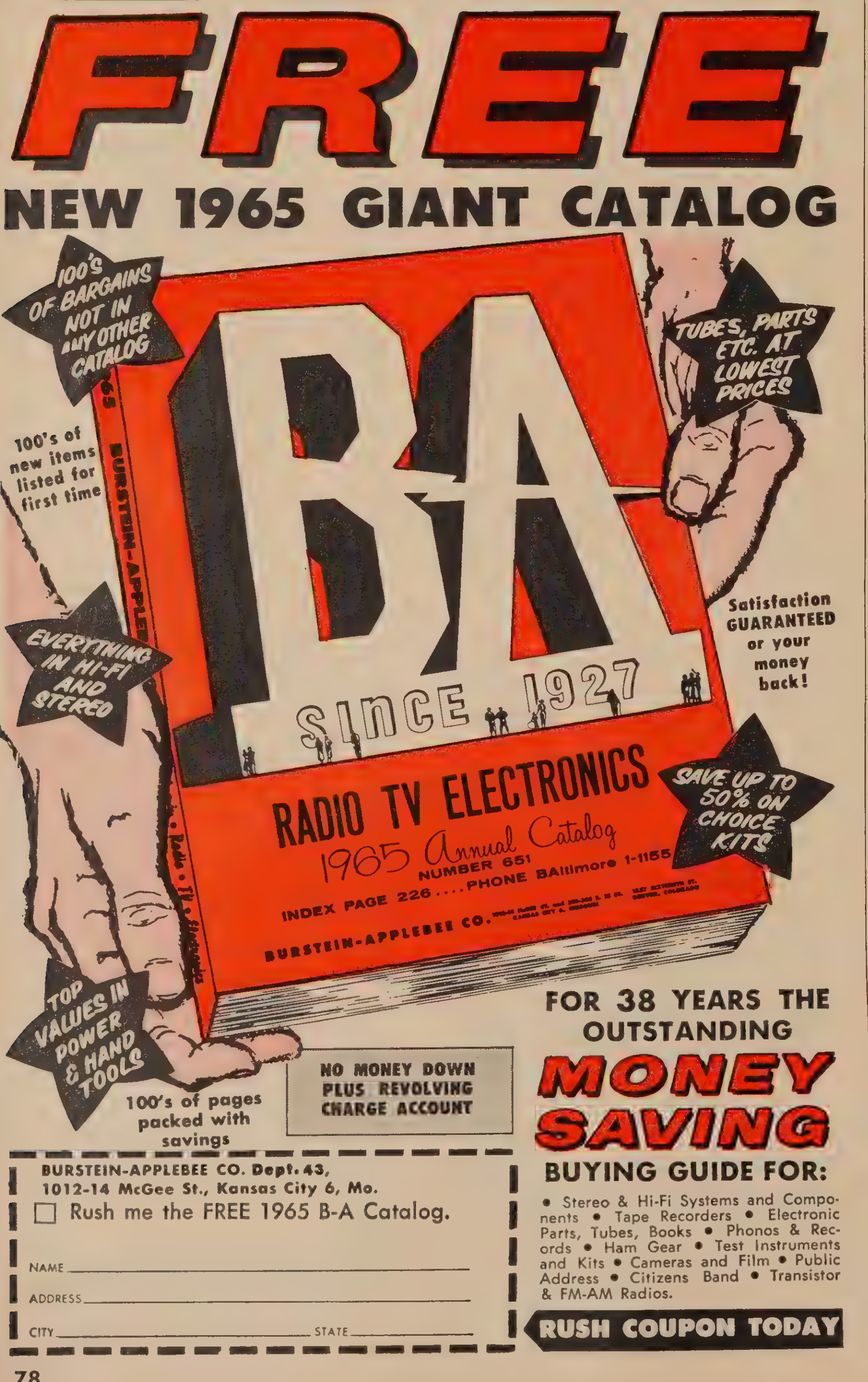
LINEAR INTEGRATED-CIRCUIT ADVANCES

Integrated circuits appear to be filtering down gradually to the consumer-product level. So it might seem from news from Motorola, which recently showed (at WESCON) eight new linear integrated circuits—among them a 10.7-mc i.f. amplifier compatible with standard transistor circuitry.

Other devices in the line were a compatible 120-mc rf amplifier, three complementary differential amplifiers, a wide-band differential amplifier and a 15-resistor ladder-divider network, made by the thin-film process.

The 120- and 10.7-mc amplifiers are monolithic compatible circuits with thin-film capacitors, developed for a 120-mc transceiver built to demonstrate integrated-circuit capabilities to the Air Force. The 120-mc amplifier (MC1935) has 18 db minimum gain at 120 mc and is the highest-frequency monolithic linear integrated circuit available.

The MC1936, the i.f. amplifier, is useful to 20 mc for i.f. applications with either L-C or R-C coupling. Both amplifiers come in TO-5 packages, and the diagram shows the circuit of the 10.7-mc amplifier. END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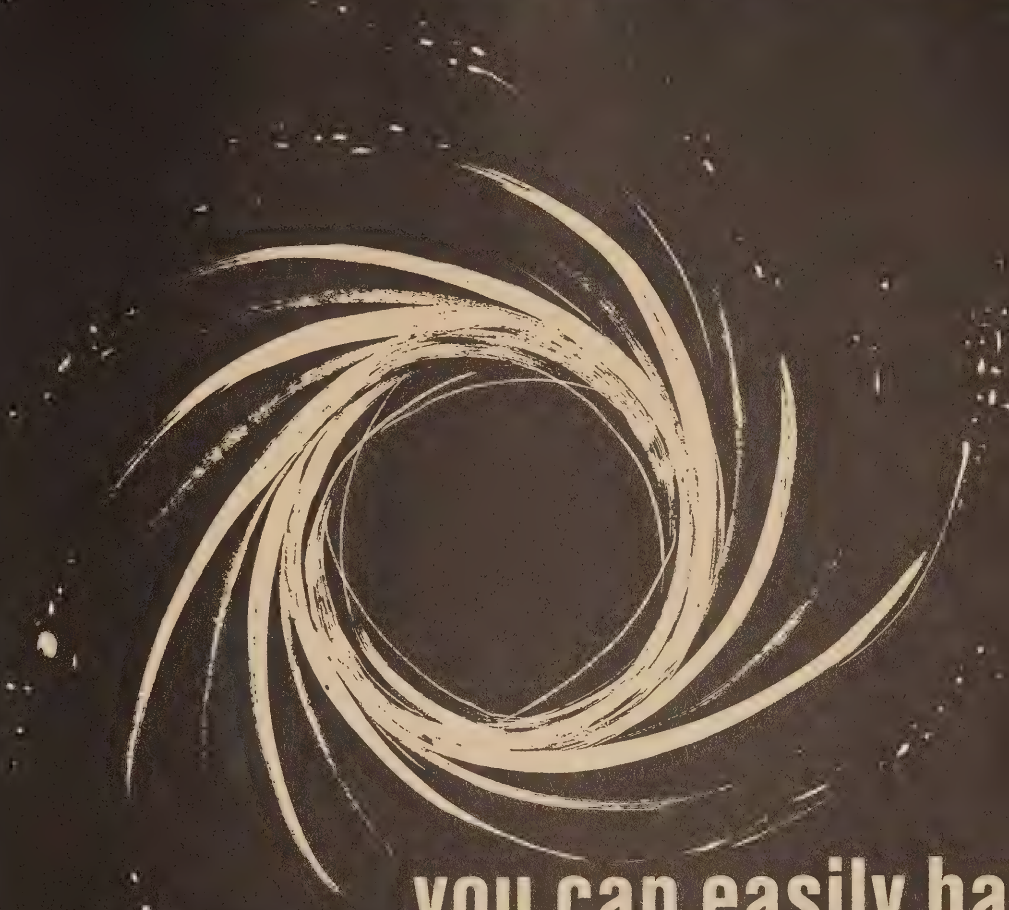

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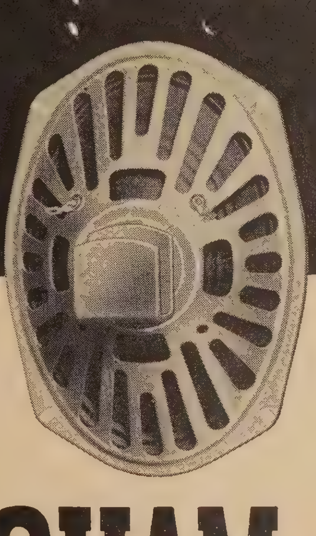

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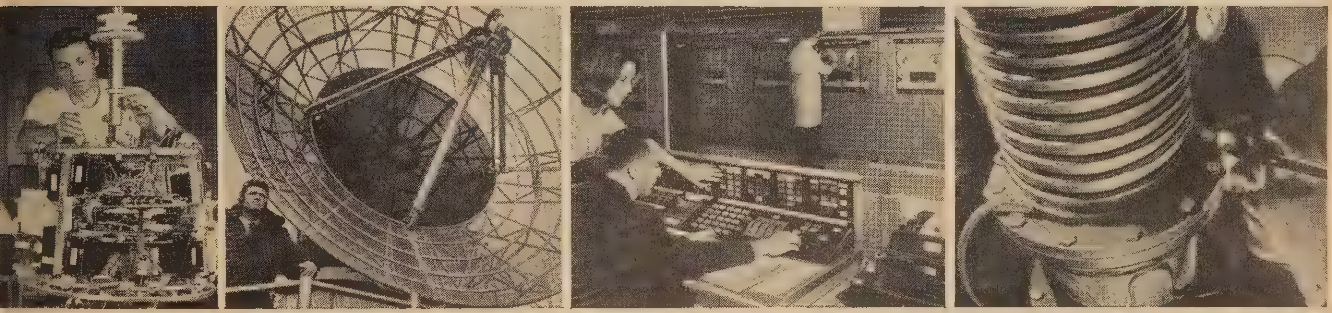

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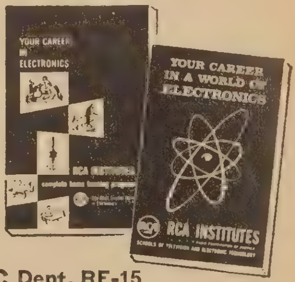
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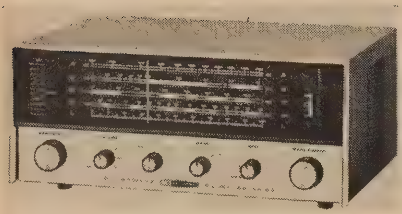
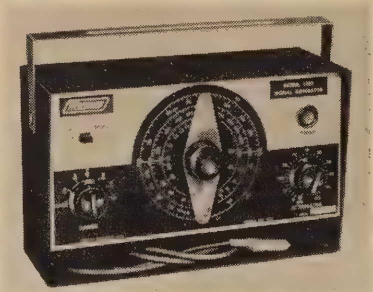
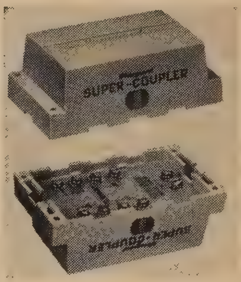


SHORT-WAVE RECEIVER KIT, the *GR-64,* covers 550-kc to 30-mc range in 4 bands. 5-in. round speaker, built-in rod antenna for broadcast band, unbalanced input for external antenna connection, high-voltage transformer-operated solid-state power supply, parallel filaments, lighted bandspread tuning bar and relative-signal-strength indicator, 1-piece molded dial, bfo, 4-tube superhet circuit plus 2 silicon diode rectifiers, headphone jack. Gray metal cabinet.—**Heath Co.,** Benton Harbor, Mich. 49023

SIGNAL GENERATOR, *model 1500,* popular-priced with high output level on all bands, will troubleshoot AM and FM radios, transistor radios, black-white and color TV, communications equipment. Has separate high-level audio output for checking hi-fi sets and video amplifiers. 7 overlapping bands, 115 kc to 110 mc.—**Mercury Electronics Corp.,** 111 Roosevelt Ave., Mineola, N.Y.



COUPLERS. *CC-200* (2-set) has isolation figure of +22 db minimum across all channels, maximum loss is —3.2 db; SWR does not exceed 1.2:1 on any channel. 5-way mount. The *CC-400* (4-set) has insertion loss of —6.23 db; impedance match of 1.2:1 on all channels, vhf and uhf, input and output.—**Winegard Co.,** 3000 Kirkwood, Burlington, Iowa



2-WATT, 2-CHANNEL WALKIE-TALKIE, *HA-300,* covers 10-mile range over favorable terrain. Has rechargeable nickel cadmium batteries, plug-in battery charger and 13 transistors, 2 diodes. Receiver is superhet with 1 rf and 2 i.f. stages, push-pull audio output and variable squelch control. Earphone and leather case.—**Lafayette Radio Corp.,** 111 Jericho Turnpike, Syosset, N.Y.

AUTOMATIC DEGAUSSING KIT, designed for all 1963-64 color sets. May also be used to modernize and update trade-in sets for better resale value. Consists of two specially designed degaussing coils, an automatic degaussing control and all necessary wiring. No drilling needed; not necessary to remove chassis when installing. Only two solder joints necessary. Comes with detailed instructions. Currently available at most electronic parts jobbers.—**Colman Electronic Products, Inc.,** PO Box 2965, Amarillo, Tex. 79105

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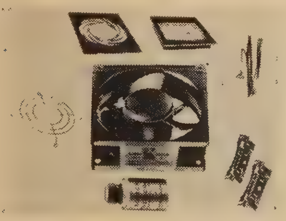
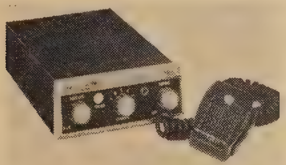
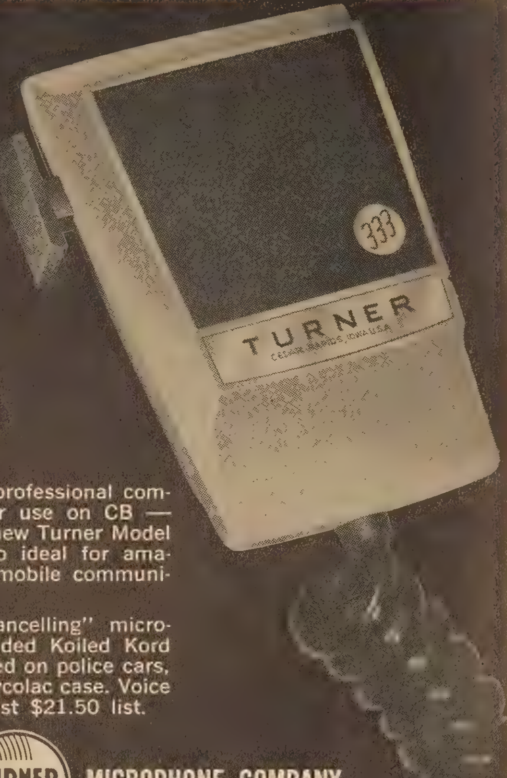


FAN ACCESSORIES, designed to accompany the *Sentinel* fan are filter assembly, spiral grill, plug and cord assembly, finger guard, mounting clips and Rotron Filtercoat.—**Rotron Mfg. Co., Inc.**, Woodstock, N. Y.



TRANSISTORIZED CB TRANSCEIVER, *model CB-10*. This 5-channel unit provides full modulation with 3.5 watts of audio output through the 3-stage transmitter. Power requirement: 1 amp max. at 12v; uses 14 transistors, 6



Turner's noise cancelling 333

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Now you can get a deluxe professional communications microphone for use on CB — and at CB prices, too. The new Turner Model 333 CB Microphone is also ideal for amateur, marine and all other mobile communications.

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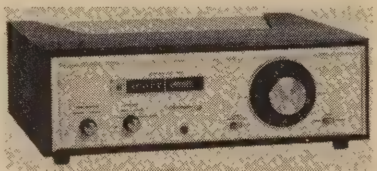

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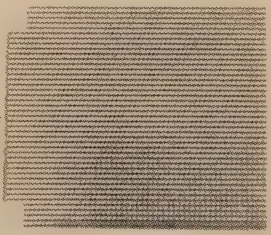

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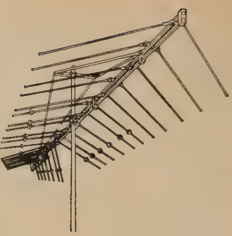

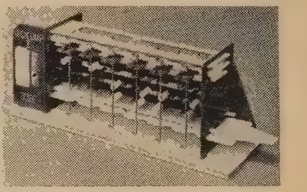

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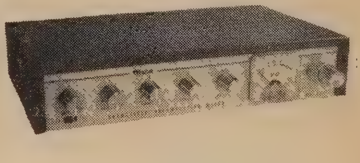

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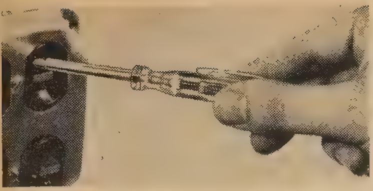

parent plastic handle has resistor and neon lamp that glows when screwdriver is applied to live line.—**Littelfuse**, 800 E. Northwest Hwy., Des Plaines, Ill.

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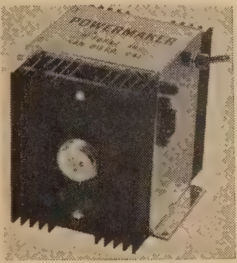

TRANSISTORIZED INVERTER, *Powermaker*, a 300-watt all-transistor inverter which changes 12-volt battery power to 120-volts, 60 cycles. 5⅝ in. square, 12 lb.—**Topaz, Inc.**, 3802 Houston St., San Diego, Calif. 92110

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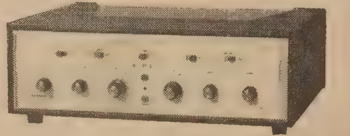

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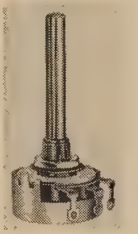

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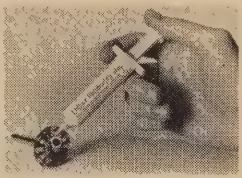

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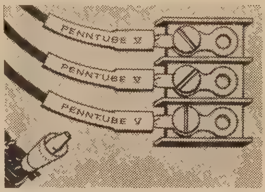

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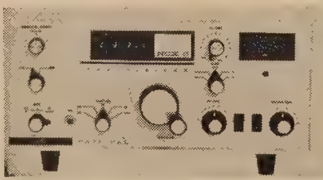
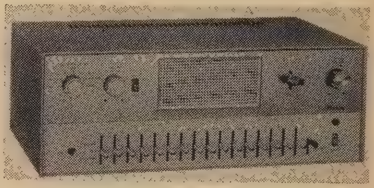
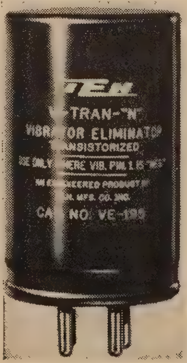


5-BAND TRANSCEIVER, *NCX-5,* for 80-, 40-, 20-, 15- and 10-meter amateur bands, essentially no warmup drift, digital dial readout calibrated to 100 cycles on each band. 2 rf stages in receiver section. Transceive vernier control allows ±5 kc receiver offset from transmitter frequency when desired. Fast attack-slow-decay agc, S-meter, full VOX or PTT operation, break-in CW keying with adjustable release time plus alc.—**National Radio Co., Inc.,** Dept P, 37 Washington St., Melrose, Mass. 02176

PROGRAM–INTERCOM CONTROL CENTER, *model S330* solid-state sound system, developed for small schools, features: dual-channel operation; separate intercom and program amplifier; acoustic noise suppressor and overload protective circuits; inputs for 3 low-impedance mikes; 3 high-impedance auxiliaries; 16 station selector keys; voice call-in facilities; selective privacy on intercom.—**Rauland-Borg Corp.,** 3535 W. Addison St., Chicago, Ill. 60618



PRODUCTION TYPE DIODE TESTER, *model ID-1017,* checks any 1-watt or higher-rated diode for short, open or improperly marked polarity. Instructions printed on cover. Load on diode being tested is No. 47 indicator lamp drawing less than 1 watt. Guaranteed, except for lamps or abuse, for 1 year.—**Henry Francis Parks Lab,** PO Box 1665, Seattle, Wash. 98125



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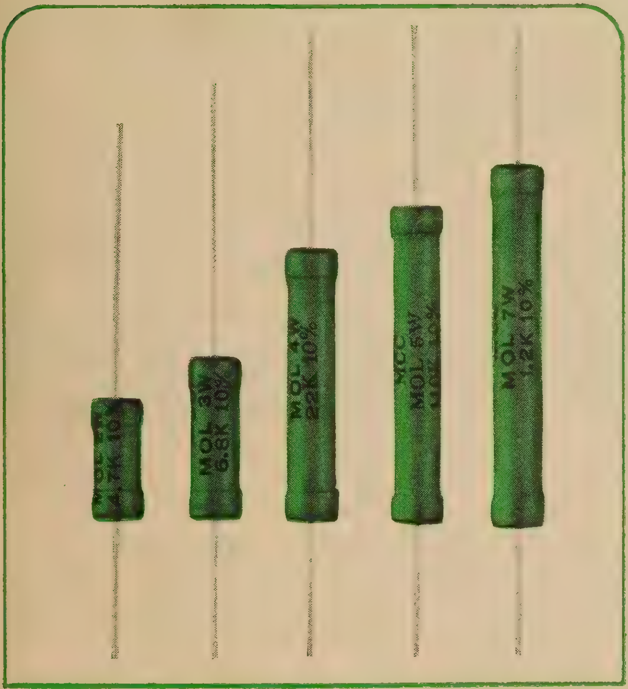

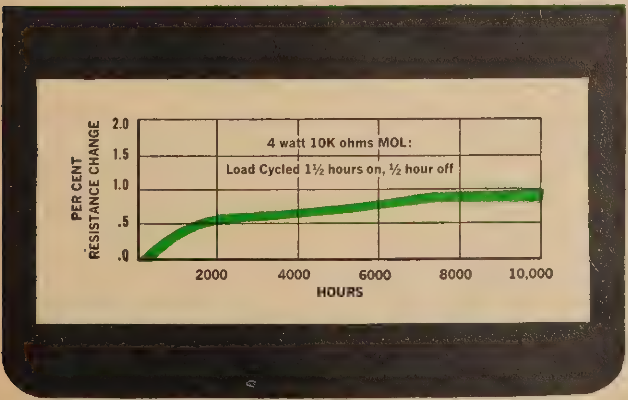

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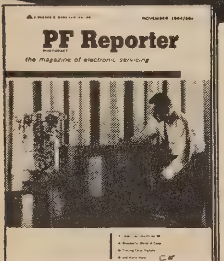

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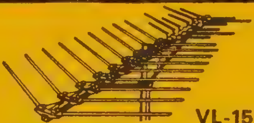

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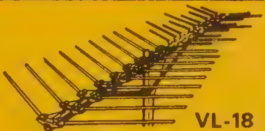

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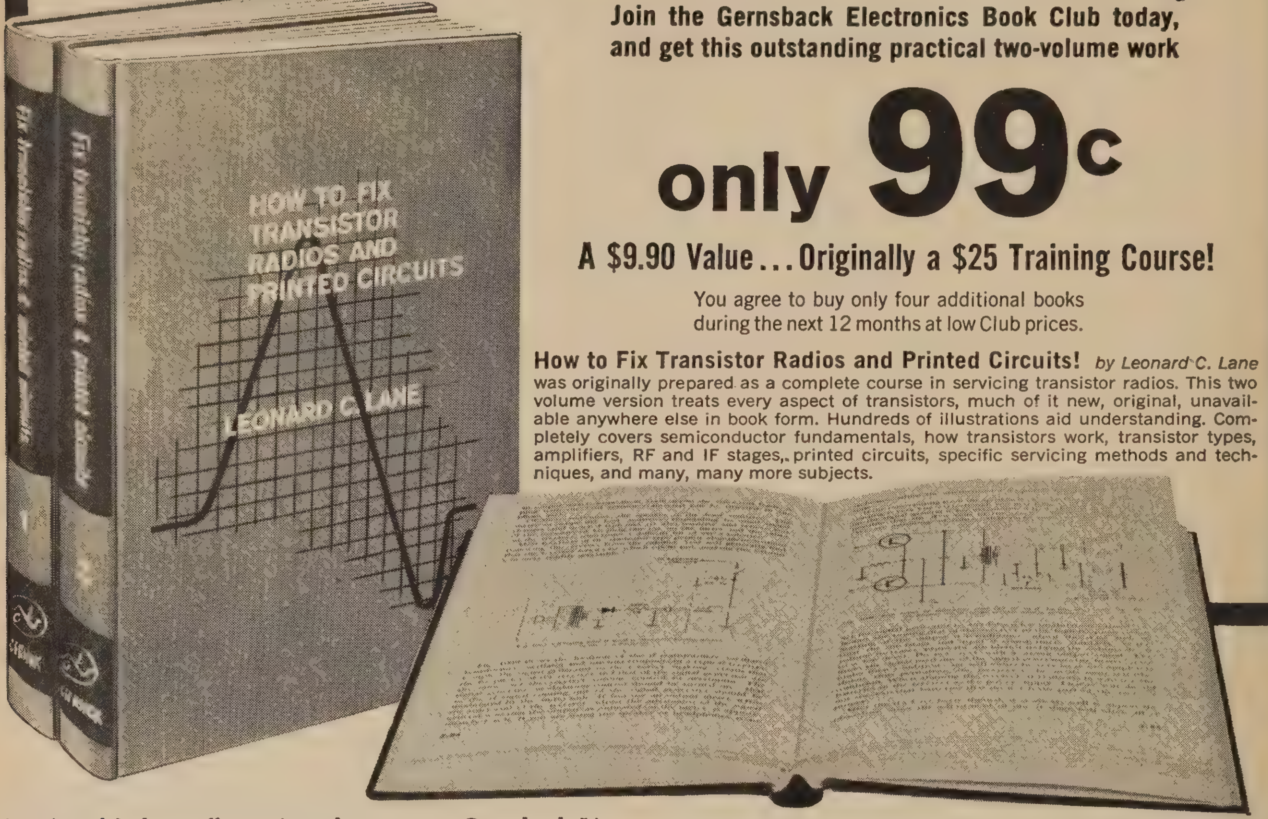

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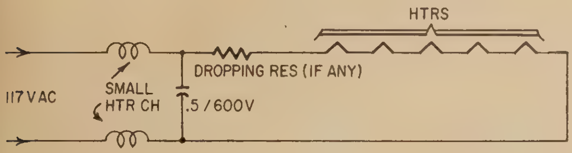
This problem occurs when the color picture tube is magnetized by a nearby lightning stroke. Degaussing the tube restores normal operation. *G-E Service Talk*

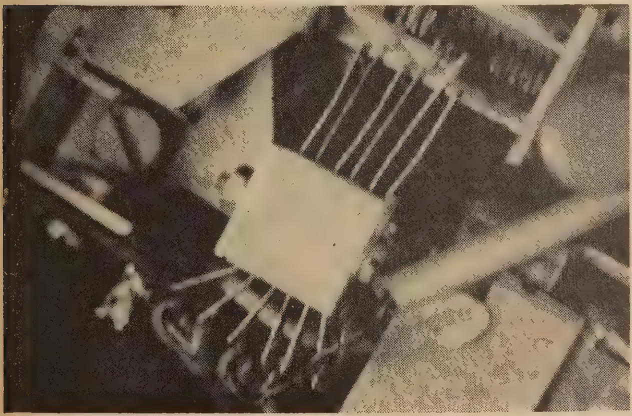
KILLING LINE NOISE IN AC-DC SETS



Electric razors, small appliances, motors, neon lights and such-like introduce noises into almost any ac-dc radio. The schematic shows how a pair of rf heater chokes and one capacitor can be wired into any ac-dc heater circuit to filter out all those noises.

Use chokes that are rated *above* the total heater current.—*A. von Zook*

UHER SR-111 RECORDER: FAULTY MUTING



When the muting contacts on these machines get dirty, they let enough audio through to make a "twittering" in the speaker as a tape is rewound. Cleaning them with a shop solvent and tightening the retaining screw usually solves the problem.

Be sure power is off when you clean the contacts. Accidentally grounding the start-magnet contacts will blow the low-voltage fuse (later machines only—on earlier models those contacts are not near the muting contacts).

On machines with serial numbers lower than 89,000, the muting contacts are just in front of the record/play head. On later machines, they are to the right of the start key.—*Steve Dow*

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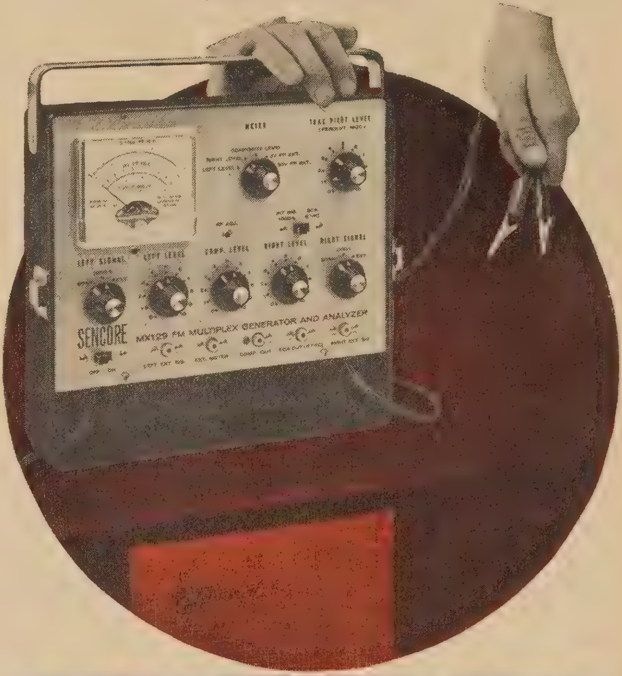

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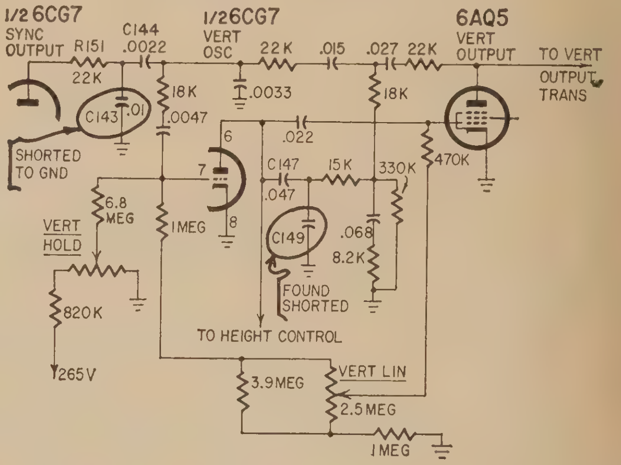
After long use, one of the most common component failures in these automatic stamp clocks is the imprint coil. The coil, an electromagnet wound with heavy-gauge enameled wire, at times develops shorted turns, probably because of humid, corrosive atmospheres and high temperatures in many factories.

One early indication of approaching imprint-coil failure is the dimming of lights on the same circuit as the clock during the moment of imprint. If you repair the stamp clock then, you will avoid later troubles, such as blowing a line fuse. The defective coil must be changed. A replacement unit is available from the Stromberg Co.—*F. G. Lewis*

RCA KCS-96: NO VERTICAL SYNC



Trouble was remedied by replacing shorted C143 (see diagram). Afterward, it was found that the height control had to be set to the end of its range to get enough height. A scope check at the vertical output grid showed a linear sawtooth instead of the normal sawtooth-plus-spike waveform.

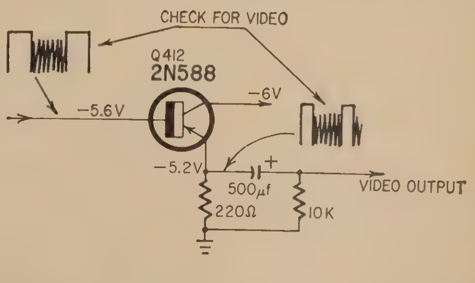
Checking the waveshaping components, I found C149 (.01 μf) had shorted to ground. Replacing it brought the set back to normal.—*Wesley Bazell*

G-E MODEL 409 FM RADIO FADING

The wiping contacts on the FM tuning capacitors had become dirty. Tapping on the side of the radio would bring stations back.

To correct this trouble, remove the shield and clean the small wiping contact springs with a good contact cleaner. Also clean the rotor of the variable capacitor where the springs touch. Sometimes it will help to bend the springs to get a better connection.—*Alfred L. Hollinden*

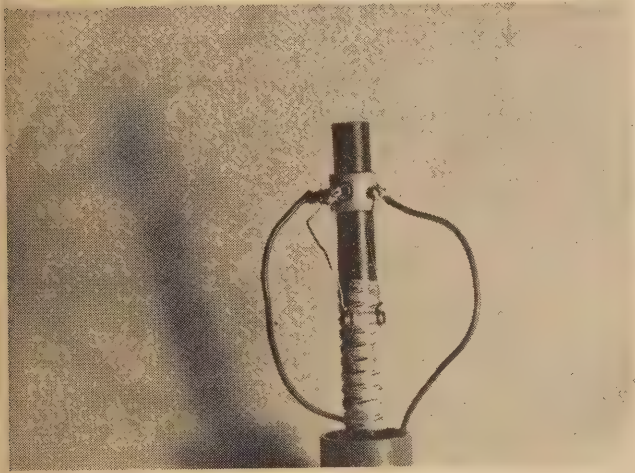
PHILCO 367 TRANSISTOR CTV CAMERAS



Removing the RG-59/U cable from the video output connector of the TV camera or at the monitor video input, with the camera power on, invariably damages the emitter-follower video output transistor because of the high transient pulse set up the instant the connection is broken.

If the user reports no picture at the monitor, check the video output transistor, Q412, type 2N588. With the camera's dust cover removed, and power applied, connect a scope to the base of the video output transistor. If a composite video signal (V or H rate) is observed there but not at the emitter, the transistor has been damaged and must be replaced. It may be purchased from most suppliers handling Philco transistors.—*F. G. Lewis*

TOY RADIOS USEFUL IN SHOP



Many five-and-ten-cent stores sell very cheap toy "rocket radios" that contain a diode, capacitor, resistor and coil. They are meant to drive a small crystal earphone. The high-Q coil can be useful for a variety of service jobs.

Disconnect the earphone and diode. Connect an extra lead to the other side of the tuned circuit and bring it out through the base. Don't disturb the fixed capacitor across the coil. Reassemble the housing (a few dabs of service cement will hold it together) and attach alligator clips to the two wires.

To align transistor radios, connect the coil–capacitor combination to your signal generator and move the rod up and down (or otherwise adjust the tuning slug) to peak the circuit for maximum radiation. You can vary the rf level radiated to the set by adjusting the slug.

Removed from the housing, the coil and capacitor make a ready-made wavetrap to reduce interference from nearby broadcast stations. Wire the coil and capacitor in series and connect the pair across the set's antenna. Tune for minimum interference. Or try them as a parallel-tuned trap in *series* with an outdoor antenna.—*Steve Dow*

continued

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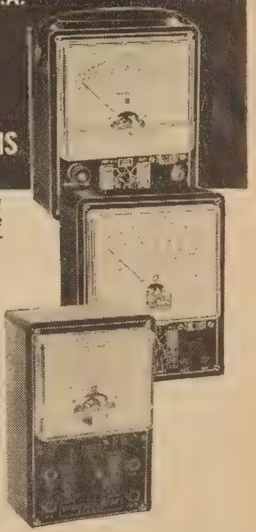

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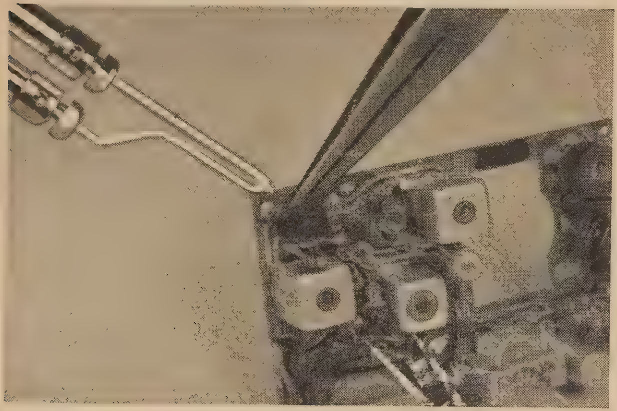
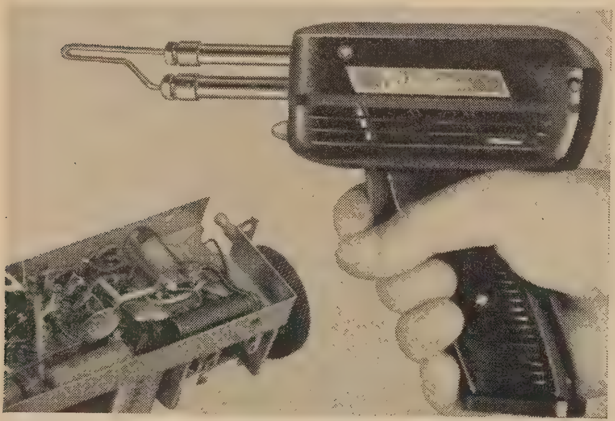
SOLDERING TIPS FOR HI-FI KIT BUILDERS



AVOID TOO MUCH HEAT

High heat can damage components. Use low heat for soldering, and a pair of long-nose pliers to hold the wire. Pliers act as a heat sink and prevent overheating.



USE A DUAL HEAT GUN

A Weller Dual Heat Gun has 2 trigger positions. One provides low heat for electronic connections; the other gives high heat when needed. You switch instantly to the right temperature for the job.

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A Weller "Expert" Kit includes 100/140 watt dual heat gun, 3 soldering tips, tip-changing wrench, flux brush, soldering aid and solder, in a plastic carrying case. Model 8200PK—$8.95 list. Weller Electric Corp., Easton, Pa.

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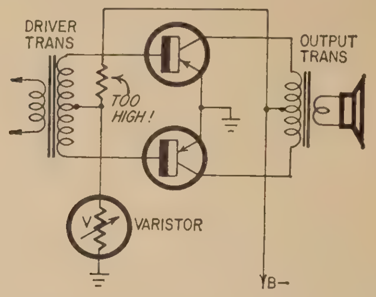


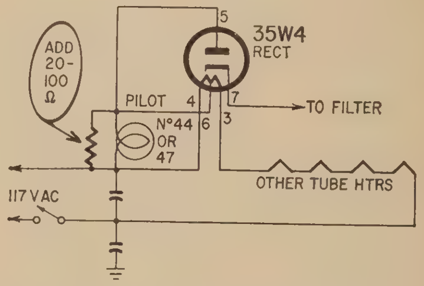
Set was brought in for "severe distortion." Symptoms (low current drain, low voltage at transformer center tap) pointed to a defective varistor between the base of the output transistors and ground. Replacing the varistor restored normal operation.

When the set was checked when the customer came to pick it up, distortion was as bad as at first. Further investigation showed exactly the same conditions as originally. The series resistor to the negative supply was then checked and found to be high. Replacing it and putting back the old varistor made a permanent repair.

Why did the new varistor cure the trouble temporarily? The heat of soldering raised its resistance so that the base was biased properly through the old resistor. When it cooled, bias dropped and distortion began.—*Steve Dow*

FREQUENT PILOT BURNOUT IN SETS WITH 35W4

Cause: 35W4 heater resistance has increased with age.



Remedies: Replace No. 47 pilot with No. 44, rated at 250 ma instead of 150. Or use a bridge resistor of 20 to 100 ohms across existing No. 47 pilot to shunt excess current around the bulb. Try different values to get the brightness you want. A good compromise value is about 50 ohms. A third solution is to connect another pilot light in parallel with the original one.—*Joseph Amorose*

HOFFMAN 21M351N: DAMPER RED-HOT

A new flyback and several routine substitutions did not cure the trouble in this set. I found low resistance readings at certain flyback terminals, but the flyback had been changed.

Pin 7 of the flyback showed a short to ground. This lead goes to damper pin 8 (heater) and via a coil-spring shield to the power transformer. I noticed that a sharp bend in the coil had been hot once. When I cut the shield open, I found it had burned through the wires' insulation.

A little plastic tape cured everything fast.—*H. A. Schornstein*

8115 SILVERTONE: BAD HORIZONTAL SYNC

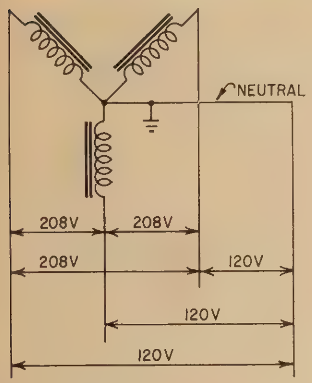
This trouble was caused by a leaky .005-μf capacitor in the five-part printed-circuit package, which is subjected to constant heat. I have found that simply replacing the network leads to recurrence of the trouble.

So I remove the entire network and install five separate components, two above and three below the sync board.—*Stanley Clark*

END

Answers to What's Your Eq?

This month's puzzles are on page 53

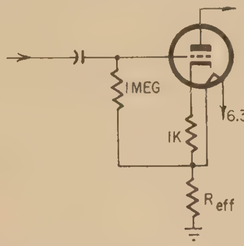


Which Motor?

The ratio of the voltages across phases to the voltage from any phase to neutral or ground on a three-phase "Y" distribution system is $\sqrt{3}$, or approximately 1.7 to 1. By multiplying our known voltage of 120 by this factor (1.732), we get 208 volts across phases. So, we order the 208-volt motor.

Hum-m-m

A common ground is often used to advantage on an amplifier stage. In this case, it was the cause of the trouble. The common ground connections shown was soldered to a lug which is grounded by a tube-socket mounting screw. This screw had a white powdery coating, evidently due to oxidation of the cadmium plating. The result—high-resistance ground!

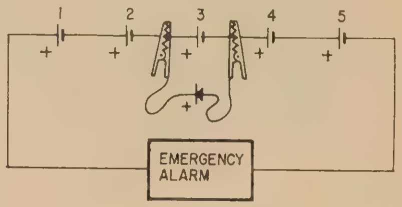


This, in effect, adds a small resistor in series with the lug to chassis. As heater current flows in this resistor, it injects a 60-cycle signal into both grid and cathode. These signals tend to partly cancel in the plate circuit, so grounding either grid or cathode increases hum.

The trouble was cured by cleaning the chassis at ground point and installing a new screw, lockwasher and nut. Probably a better method would be to solder the lug directly to the chassis for a permanent cure.

Emergency

A rectifier with attached alligator clips is applied as shown. This allows current flow to bypass No. 3 cell and continue through load. The rectifier is back-biased with respect to this cell, so there is no short circuit.



The cell and connecting straps can now be removed, cleaned and replaced with no current interruption or shorting of the cell. Caution! be certain to observe correct polarity when you connect the rectifier. END

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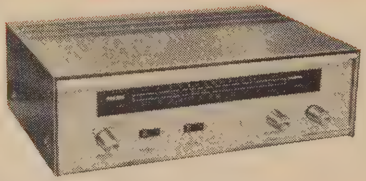
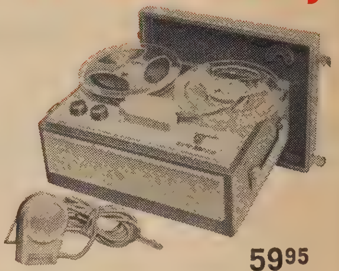


93⁹⁵

New LT-325 AM/FM Multiplex Tuner combines simplicity, flexibility, and superb styling. 20-Tube performance provides a great variety of features, including a new audible tone "Stereo Search System." Imported, **99-0001WX.**



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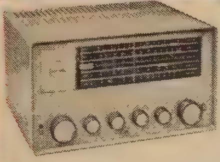

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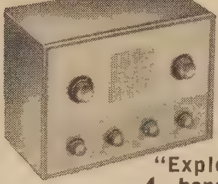
Deluxe Model HA-63 Shortwave Receiver is an excellent choice for the beginning shortwave listener or novice amateur. Covers 550 KC to 30mc in 4 bands and features electrical bandspread on all frequencies. 7 Tube circuitry gives outstanding selectivity and sensitivity. Imported, **99-2534WX**



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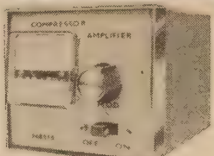

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The New Model HA-115 audio compressor amplifier instantly and automatically increases the "talking power" of your citizens band transceiver by increasing the average modulation of the transmitter section. Works with all popular CB units. **42-0117.**

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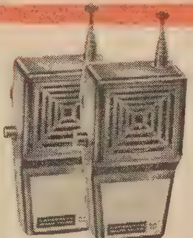

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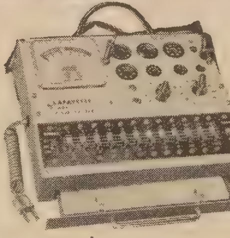

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technicians' News

TSA–OHIO HITS CABLE TV

The Television Service Association of Ohio has distributed a resolution against cable antenna television systems (CATV). The resolution was approved by the group at its convention in Akron last fall.

TSA-Ohio has thus joined the growing ranks of TV service associations on record as opposing strongly any form of piped-in television wherever individually owned antennas can provide satisfactory reception.

The resolution notes that "the advent of full pay-television would . . .be . . . to the financial disadvantage of the viewing consumer." Most of the text is the same as that of the NEA resolution, parts of which were quoted in Technicians' News in the December issue of RADIO-ELECTRONICS.

LABOR DEPT. APPRENTICESHIP PROGRAM: DETAILS

The Department of Labor reports increased interest in the model on-the-job program for training electronic service technicians. Under the program, apprentices go to school one or two nights a week, while they work full-time during the day. The training period is 4 years, or at least 8,000 hours of actual work experience. An apprentice gets regular salary increases at the end of each 6-month period, up to the standardized "journeyman" wage for the area.

A local apprenticeship and training committee establishes the qualifications of men who apply for training under the program.

Besides the night-school academic training, apprentices are trained in counter service and general sales, service calls, installation of various types of electronic gear, repairing radios, TV sets and other electronics, and paperwork—preparing job tickets, invoices and so forth.

New Mexico has apparently had considerable success with its training program, which served as a model for the one approved by the Labor Department. In view of recent complaints and surveys indicating that the TV service industry is having a hard time attracting "young blood", this training program, with its suggestion of dignity and thoroughness, should be a help.

NATESA has announced the opening of its Office of Job Training in Washington, D. C. It is located in Room 235 of the Woodward Building, 733 Fifteenth St. NW. The telephone number is 737-0221 (area code 202).

Mr. Vincent Lutz, past president of NATESA, is in charge. As National Training Coordinator, his services will be available without charge to any electronic service group wishing to develop an on-the-job training program under provisions of the Manpower Development and Training Act of 1962. Information on such provisions is also available. Requests should be directed to the office above.

Mr. Lutz was told in a letter from Hugh C. Murphy, US Labor Department Bureau of Apprenticeship and training administrator, that the new apprenticeship standards drawn up by NATESA fill a deep need for the "proper and complete training of apprentices as Electronic Technician (Radio, Television and Electronic Equip-

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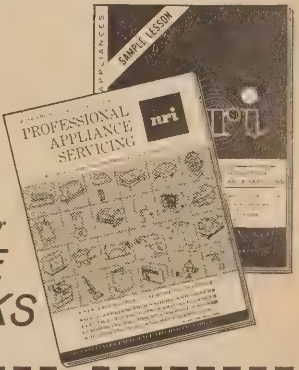

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COLMAN ELECTRONICS
Amarillo, Texas

Vincent Lutz, recently appointed National Training Coordinator for NATESA's On-the-Job Training program.

ment)." The letter gave official government approval of the standards.

Mr. Lutz is also acting as field representative, meeting with groups interested in establishing a training program under On-the-Job Training (OJT).

TESA–Washington, D. C. is developing an OJT program, and Roanoke and Lynchburg, Va., have expressed interest.

Information is available either from the Washington OJT office of NATESA, or from NATESA, 5908 S. Troy St., Chicago, Ill. 60629.

AUTOMATIC SERVICING A FACT IN NEW TELEPHONE SYSTEM

The electronic telephone-switching system developed by Bell approaches complete automation in maintenance. It is designed to operate with less than 1 hour "down time" in 40 years. Every important part of the system is duplicated, and the duplicates operate together.

Scanners continually check each portion of the system, comparing the performance of the duplicates. If one member of a pair indicates abnormal operation, it is switched off automatically and its partner takes over alone. A teletypewriter prints out a diagnosis of the trouble. A series of numbers, which the maintenance technician looks up in a "trouble dictionary," tells him what circuit pack is likely to be involved. His job is to replace it with a new one. The system then checks the unit, and, if it is OK, switches it back into service.

More than half the programs in the new system's long-term memory (program store) are for maintenance operations. END

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The receiver and its performance (without the Oldsmobile) are described in *Physical Review*, Vol. XV, No. 1, page 39, (July, 1902) "Wireless Telegraphy with a Relay-telephone Receiver."

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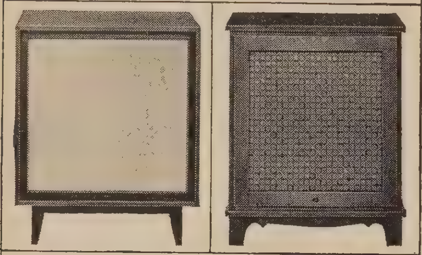

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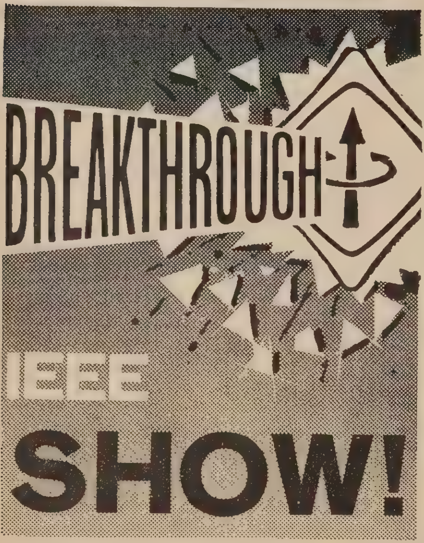

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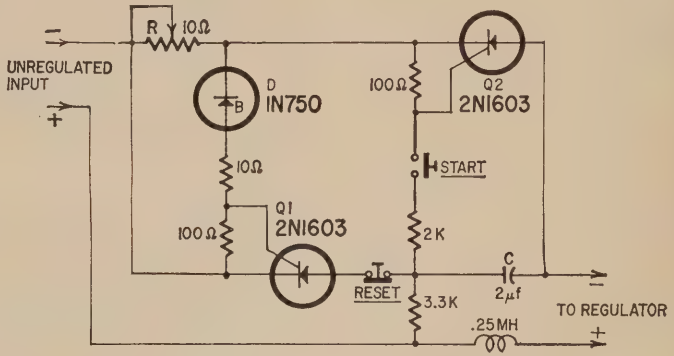
noteworthy Circuits

SCR CIRCUIT BREAKER

A number of methods to protect solid-state voltage regulators against current overloads have been developed. One popular regulated supply uses a fast-acting relay with a bias winding. This SCR circuit breaker, designed by Texas Instruments in Holland, was described in *Electrical Design News.*

Two SCR's are used. Q2 is the series "circuit breaker" and Q1 and Zener diode D form the "trigger." Pressing the START switch causes current to flow between the gate and cathode to fire Q2. Load current flows through adjustable resistor R and Q2. The capacitor charges to the level of the unregulated supply.

When the load current exceeds a level determined by the setting of R and the Zener voltage of D, the Zener diode breaks down and turns on Q1. This places a virtual short across C. The capacitor discharges almost instantaneously, back-biasing Q2 and breaking the circuit to the regulator and load. The 3,300-ohm resistor provides a load for the unregulated power supply. Opening the RESET switch cuts off Q1 so that current can be restored to the regulator when the START button is pressed.



SIMPLER SLAVE FLASH

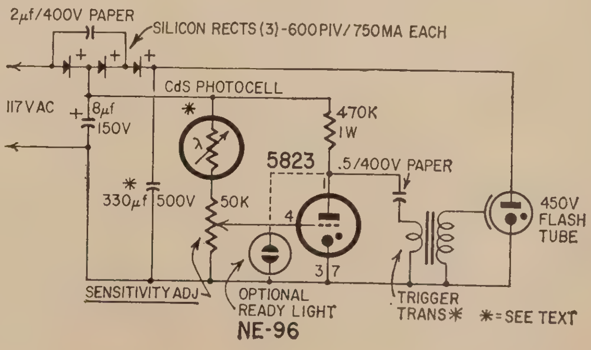
Multiple-flash photographic setups are generally used indoors or in studios where a convenient source of power is no problem. Yet many modern photoflash slave units use batteries and a transistor power supply, so they are wasteful and expensive to operate.

Here is a simple and inexpensive photoflash slave that has neither batteries, transistors nor power transformer. It is designed around a voltage-tripler power supply, a cold-cathode trigger tube and a CdS photoresistive photocell. It cycles in 3 to 5 seconds so a ready-light is superfluous. If you need one, connect a NE-96 neon lamp as shown in dashed lines.

The flash lamp is a Kemlite 450-volt 100-watter. The charging capacitor was made by paralleling several computer-grade electrolytics. You can use a standard 525-μf photoflash capacitor. The photocell is a Fafayette 19G2101 You can use any similar cell whose resistance ranges from 10 megohms in total darkness to around 200 ohms at 100 foot-candles. For the trigger transformer, you can use one made for this purpose, a model-airplane ignition coil or a flash tube with built-in transformer.

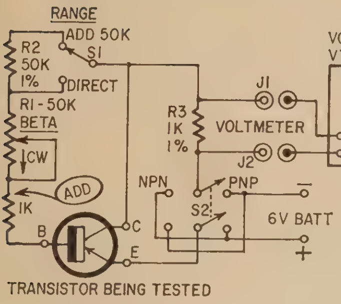
This unit is so sensitive that it can be triggered by the beam of a flashlight, making it useful for stopped-down apertures and time exposure.—*Tom Jaski*

END



try This one

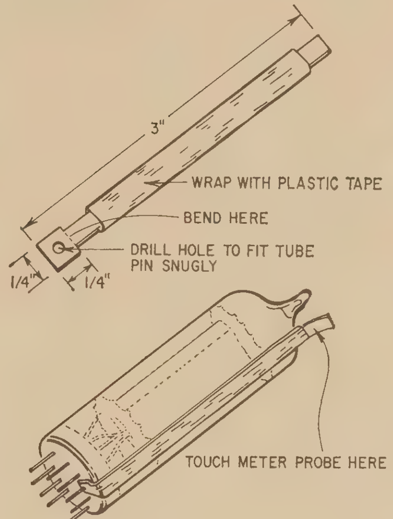
MODIFIED TRANSISTOR GAIN CHECKER



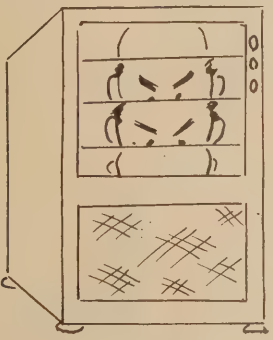
Regarding the "Transistor Gain Checker" described in Noteworthy Circuits on page 114 of the January 1961 issue of Radio-Electronics: The 1,000-ohm resistor R3 in series with the battery carries both the collector and base currents. Thus the measuring procedure described does not measure beta directly, but rather measures the quantity (beta + 1). This can be overcome by recalibrating potentiometer R1 or by inserting an additional 1,000-ohm resistor in series with the base.

Also, the effect of battery voltage on accuracy can be eliminated by reading the battery voltage and then setting for exactly half that voltage instead of an arbitrary 3 volts.—*Charles Erwin Cohn*

YOU DON'T NEED A TEST SOCKET



Want to check the voltages at the pins or a seven- or nine-pin miniature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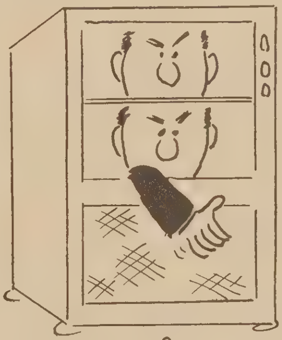
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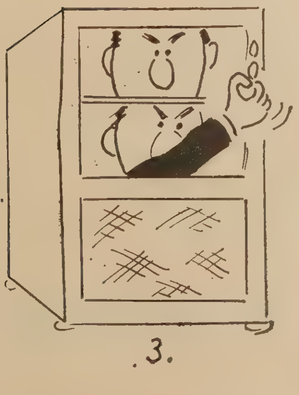
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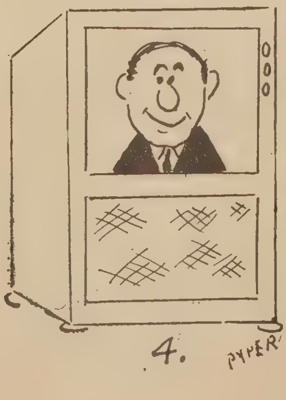
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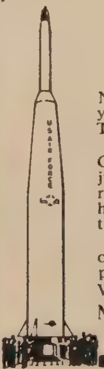

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TRY THIS ONE continued

tube while it's in use? Just make up the little adapter shown in the diagram from a scrap of sheet metal.

To use it, pull the tube, slip the adapter over the pin whose voltage you want to check, and plug the tube back in. Now turn on the set, touch the meter probe to the top end of the adapter and touch the other probe to the chassis.—*Warren Roy*

INDICATING FUSE HOLDERS TURN PILOTS, SAVE SPACE

At least two manufacturers make a series of fuse holders that indicate a blown fuse by a small neon light in the fuse-holder cap. While this is a convenience, it is seldom necessary; there are other ways to determine a blown fuse. With a little rewiring, the lamp in the holder can be used to indicate that the instrument is on.

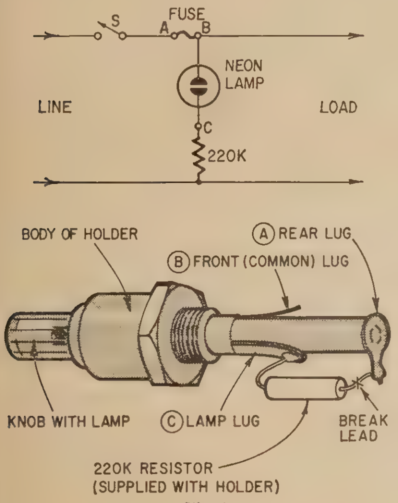


Fig.1

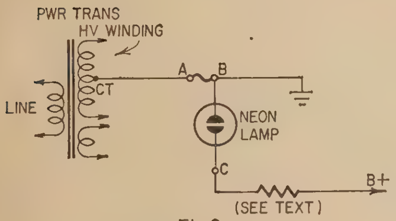


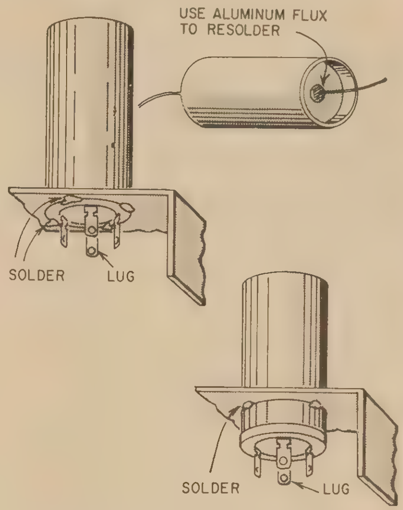
Fig.2

Connect the lug from the back of the holder as usual (Fig. 1) to the hot lead from the power switch. Connect the other fuse lug to the load. Break resistor lead to the back lug and reconnect it to the other side of the supply. That's all there is to it. Suggested fuse holders are the Buss HKL and HKL-X and the Littelfuse 344125A.

The same arrangement may be used in the B-plus line. The wiring is shown in Fig. 2. When voltages greater than 300 are involved, the 220,000-ohm resistor supplied with the holder should be replaced with 680,000 ohms to protect the lamp.—*Matthew Fichtenbaum, WA2UFD*

ALUMINUM SOLDER HELPS TO SALVAGE OLD ELECTROLYTICS

To reuse old but still good can type electrolytic capacitors with broken-off mounting lugs, use some aluminum flux or solder and solder the can right into the chassis.



If, when replacing an electrolytic capacitor, you can only get one too tall for the room above chassis, enlarge the hole for the capacitor to fit the outside of the new can snugly, and slip the can *through* the chassis. Solder it in place.

When a capacitor lead breaks off,

Sing a song
of Christ-mas,
A stock-ing full
of cheer;
Christ-mas Seals
on all your mail
Will mean a
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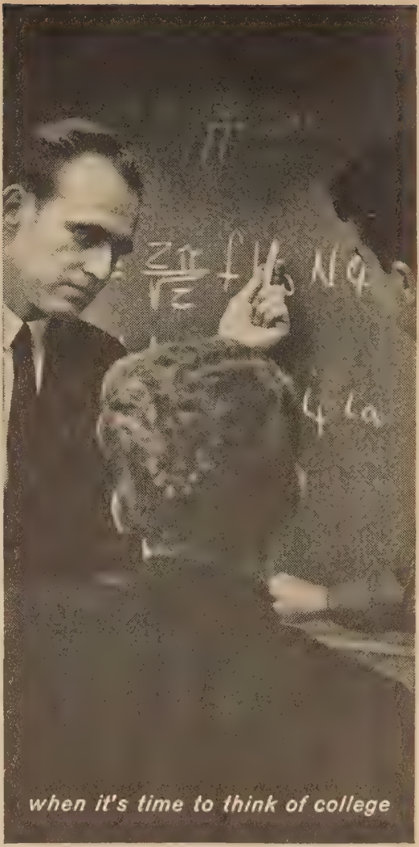
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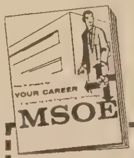

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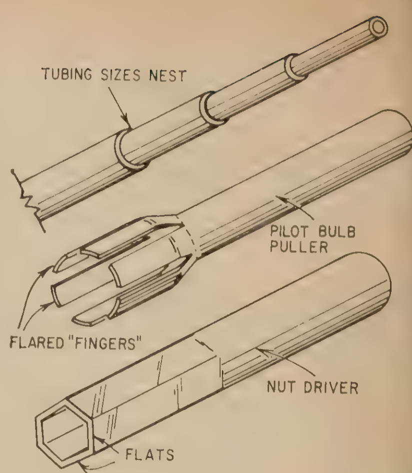
solder it back on with aluminum flux or solder. —*Tom Jaski*

BRASS TUBING: VERSATILE TOOLBOX ACCESSORY

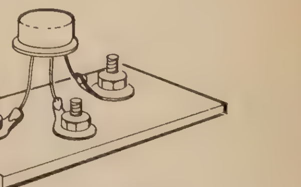
In my tool box I carry several lengths of thin brass tubing, obtained in any hobby shop. The pieces of tubing nest, and thus take up little space. All sizes up to ⅜-inch outside diameter are available in $\frac{1}{32}$-inch steps. This tubing comes in handy for many purposes. When I had to remove inaccessible pilot bulbs (Heath AJ-10 tuner), I quickly made a bulb remover with tin snips from ⅜-inch tubing, as shown. When I encounter odd-size nuts (in European sets, for instance), I can readily produce a temporary nut driver from tubing with a pair of long-nose pliers.

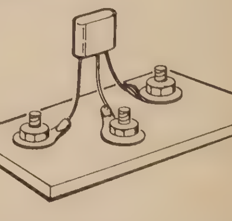


By inserting one end into a proper-size piece of brass tubing, I can lengthen almost any alignment tool. A piece of brass tubing can make a handy pickup for dropped hardware. If I need a drill gage, a length of tubing slipped over the drill will insure proper depth of drilling. There are numerous other uses for the tubing, which does not represent a major investment and can help you out of many predicaments.—*J. H. Thomas*

MOUNTING BOARD PROTECTS TRANSISTOR LEADS

Fed up with transistor leads that got shorter and shorter every time I disconnected and reconnected them in experimental circuits, I came up with a heavy-duty transistor base you might want to try.





Cut a 2 x 2-inch piece of Masonite. Select three 4-40 or 6-32 nuts and bolts for terminals. Cut each bolt to a total length of ½ inch plus the board thickness. Drill three holes in the base to pass the screws. (The holes may be in line, as for a Raytheon CK-722 transistor, for example, or at three corners of a small square, for transistors in TO-1, TO-5, etc., round cases.)

Solder each transistor lead to a

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0Y4	1.20
0Z4	.77
1A3	.73
1A5	.73
1A6	.73
1A7	1.30
1AB5	.77
1AE4	1.34
1AF4	1.30
1AG4	2.20
1AJ5	.48
1AX2	.60
1B3	.77
1B5	.98
1C5	.73
1C6	.73
1D5GP	.98
1D7	.78
1D8	2.20
1DN5	.53
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1E7	.87
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1F5	.73
1F6	1.20
1G3	.77
1G4	.69
1G6	.80
1H4	.95
1H5	1.00
1H6	.73
1J3	.77
1J5	.98
1J6	.98
1K3	.77
1L4	.66
1L6	1.69
1LA4	1.30
1LA5	2.50
1LA6	1.45
1LB4	1.80
1LC5	1.05
1LC6	1.80
1LD5	1.95
1LE3	1.30
1LG5	1.98
1LH4	.87
1LN5	.57
1N5	.87
1P5	.98
1Q5	.98
1R4	.80
1R5	.75
1S2A	1.25
1S4	1.05
1S5	.70
1T4	.70
1T5	.80
1U4	.70
1U5	.63
1V	1.05
1V2	.50
1X2B	.80
1Z2	3.25
2A3	2.50
2A5	1.25
2A6	2.75
2A7	1.50
2AF4A	.93
2AH2	1.23
2AS2	.70
2B3	.98
2B7	.70
2BN4	.62
2CY5	.68
2D21W	.79
2DZ4	.79
2EA5	.68
2EN5	.49
2ER5	1.65
2FH5	.74
2FQ5	.99
2FS5	1.47
2GK5	.59
2GW5	2.40
2HK5	.98
2X2	.60
2X2A	1.30
3A2	1.20
3A3	.74
3A4	.58
3A5	1.10
3AF4	.99
3AL5	.44
3AT2	.71
3AU6	.52
3AV6	.40
3AW3	.72
3B2	3.45
3B7	1.35
3BA6	.49
3BC5	.61
3BE6	.54
3BN4	.76
3BN6	.73
3BU8	.76
3BY6	.56
3BZ6	.54
3CB6	.54
3CE5	.56
3CS6	.56
3CF6	.62
3CY5	.69
3D6	1.48
3DG4	.83
3DK6	.58
3DT6	.52
3DZ4	.79
3EH7	.60
3EJ7	.60
3ER5	.86
3FH5	.63
3FS5	.74
3GK5	.59
3GW5	.53
3HA5	.99
3HK5	.59
3HS8	1.29
3Q4	.61
3Q5	2.00
3S4	.73
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4BC8	1.00
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4GM6	.58
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4GZ5	1.49
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4JD6	1.64
5AM8	.77
5AN8	.88
5AQ5	.52
5AR4	1.99
5AS8	1.75
5AT8	.81
5AV8	.98
5AZ4	.73
5B8	2.12
5BC3	1.31
5BE8	.81
5BK7	.84
5BQ7	.99
5BR8	.81
5BT8	.79
5BW8	1.31
5CG8	.79
5CL8	.74
5CM8	.88
5CQ8	.82
5CZ5	.70
5DE8	.81
5DJ4	.77
5EA8	.78
5ES8	1.11
5EU8	.78
5EW6	.56
5FG7	.67
5FV8	.77
5GH8	.62
5GJ7	1.60
5GM6	1.04
5GX6	.54
5HC7	1.49
5HG8	1.95
5J6	.70
5KE8	1.24
5T4	.84
5T8	.84
5U4	.58
5U8	.82
5V3	.88
5V4	1.45
5V6	.54
5W4	1.75
5X4	.90
5X8	.80
5Y3	.44
5Y4	.64
5Z3	1.50
5Z4	1.75
6A3	2.75
6A4	.78
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6A7	1.10
6A8GT	1.10
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6AU6	.50
6AU7	.70
6AU8	.85
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6AV6	.39
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6BA6	.48
6BA7	.98
6BA8	.88
6BA11	1.22
6BC4	2.10
6BC5	.59
6BC7	.88
6BC8	1.00
6BD5	1.20
6BD6	.55
6BF3	.71
6BE6	.53
6BF5	.88
6BF6	.42
6BF8	1.70
6BG6	1.65
6BH6	.66
6BH8	.94
6BJ6	.63
6BJ7	.77
6BJ8	1.45
6BK4	1.75
6BK5	.91
6BK7	.84
6BL7	1.05
6BL8	.97
6BN4	.60
6BN6	.70
6BN8	.67
6BQ5	.63
6BQ6/ 6CU6	1.08
6BQ7	.98
6BR8	.80
6BS8	.93
6BU8	.68
6BV8	1.23
6BW8	1.35
6BX7	1.09
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6BY6	.60
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6BZ8	1.06
6C4	.43
6C5	1.40
6C6	.87
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6C10	1.55
6CA4	.47
6CA5	.77
6CA7	2.25
6CB5	2.05
6CB6	.53
6CD6	1.47
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6CL8	.77
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6CM7	.67
6CM8	1.02
6CN7	.68
6CO4	1.35
6CQ7	1.80
6CQ8	.90
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6CS6	.55
6CS7	.67
6CU5	.56
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6CU8	.99
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6CW5	.78
6CX8	1.82
6CY5	.68
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6D4	1.75
6D6	.67
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6DT5	.79
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6DV4	2.65
6DW4	.90
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6E5	2.25
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6EU8	.77
6EV5	.73
6EW6	.55
6EW7	.78
6EY6	.73
6EX6	3.65
6EZ5	.88
6EZ8	.93
6FA7	1.32
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6FQ7	.56
6FS5	1.45
6FV6	.68
6FV8	.77
6FW5	1.96
6FW8	4.25
6FY5	1.25
6G5	1.23
6G6G	1.00
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6GV5	.98
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6GY5	.53
6GY6	1.10
6GZ5	.53
6HA5	.99
6HB5	2.09
6HF5	1.90
6HF8	1.25
6HG8	1.95
6HJ8	.80
6HK5	.59
6HL8	.71
6HS8	.79
6HZ6	.56
6H6	.56
6J4	2.95
6JB6	.98
6JC8	.74
6JE6	2.00
6JE8	1.50
6J5M	.92
6J6	.69
6J7	1.65
6J8	1.40
6J11	1.83
6JH6	.55
6JH8	1.85
6JK8	.68
6JT8	1.75
6JV8	.68
6JZ8	.83
6K6	.61
6K7	.95
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6K8GT	.87
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6L6GB	1.50
6L6GC	1.65
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6L7	1.05
6M11	1.85
6N6	1.45
6N7	.96
6P5	.95
6Q7GT	1.27
6Q7-M	1.45
6Q11	1.05
6R7	1.25
6S4	.49
6S7	.90
6S8	.74
6SA7GT	.97
6SA7-M	1.25
6SB7Y	1.15
6SG7	1.10
6SD7	.70
6SF5	.75
6SF7	1.00
6SG7	.85
6SH7	.97
6SJ7GT	.90
6SJ7M	1.02
6SK7GT	.63
6SK7M	1.46
6SLGT	.81
6SN7	.63
6SQ7	.92
6SR7	1.00
6SS7	.95
6SZ7	.95
6T4	.96
6T8	.83
6U5	1.75
6U8	.81
6V3	1.10
6V4	.59
6V6GT	.52
6V6M	2.50
6W4	.60
6W6	.69
6X4	.39
6X5	.51
6X8	.78
6Y6	1.00
7A4	.87
7A5	.87
7A6	1.15
7A7	.87
7A8	.66
7AD7	1.15
7AF7	1.45
7AG7	.87
7AH7	1.25
7AU7	.63
7B4	1.45
7B5	.87
7B6	.87
7B7	.87
7B8	1.25
7C4	.69
7C5	1.35
7C6	.87
7C7	.89
7E5	.87
7E6	1.15
7E7	1.25
7EY6	.73
7F7	1.75
7F8	.88
7G7	1.25
7H7	1.35
7HG8	1.50
7J7	1.95
7K7	1.95
7L7	1.95
7N7	1.95
7Q7	.87
7R7	.87
7S7	.87
7V7	1.85
7W7	1.85
7X6	1.25
7X7	1.85
7Y4	.67
7Y7	1.25
7Z4	.87
8AU8	.88
8AW8	.91
8BH8	.87
8BQ5	.61
8CG7	.61
8CM7	.69
8CN7	.95
8CS7	.72
8CX8	.89
8EB8	.92
8EM5	1.15
8ET7	1.08
8FQ7	.54
8GJ7	1.59
8GN8	.97
8JV8	.93
8KA8	.84
9A8	.98
9AU7	.67
9BR7	1.32
9CL8	.77
9EA8	.66
9U8	.80
10AL11	1.09
10BQ5	.89
10C8	1.03
10DE7	.73
10DX8	1.36
10EG7	.86
10EM7	1.75
10EW7	.97
10GN8	.93
10HT8	1.12
10JA8	.92
10KU8	1.07
10Y	.73
11CY7	.73
11JE8	1.70
11KV8	1.52
12A4	.59
12A5	.95
12A6	.85
12A7	1.45
12A8	3.00
12A11	1.74
12AB5	.58
12AC6	.53
12AD6	.55
12AE6	.48
12AE7	.92
12AF3	.71
12AF6	.65
12AG6	.60
12AJ6	.60
12AL5	.45
12AL8	.93
12AL11	1.05
12AQ5	.58
12AT6	.48
12AT7	.74
12AU6	.49
12AU7	.59
12AV5	.93
12AV6	.39
12AV7	.80
12AW6	.98
12AX3	.63
12AX4	.65
12AX6	.62
12AX7	.61
12AY7	1.42
12AZ7	.84
12B4	.66
12BA6	.49
12BA7	.82
12BD6	.48
12BE3	.67
12BE6	.51
12BF6	.58
12BH7	.75
12BK5	.98
12BL6	.54
12BN6	.97
12BQ6/ CU6	1.11
12BR7	.72
12BV7	.74
12BW4	1.09
12BY7	.75
12BZ6	.75
12BZ7	.84
12C5	.56
12CA5	.60
12CN5	.54
12CR6	.65
12CS6	.63
12CT8	1.60
12CU6/ BQ6	1.05
12CX6	.52
12D4	.67
12DB5	.67
12DE5	.60
12DE8	.81
12DL8	.85
12DQ6	1.02
12DQ7	1.33
12DS7	.82
12DT5	.74
12DT7	.77
12DT8	.76
12DW7	1.20
12DY8	1.75
12DW8	.87
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12EK6	.60
12EL6	.48
12EL8	.86
12EZ6	.55
12F5	1.50
12F8	.64
12FA6	.77
12FK6	.48
12FM6	.48
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12GC6	1.04
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12SQ7GT	.89
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12U7	.60
12V6	.62
12W6	.69
12X4	.45
13DE7	.73
13DR7	.72
13EM7	1.95
13FD7	.84
13FM7	.78
13GF7	.78
14A4	1.25
14A5	1.10
14A7	.87
14AF7	1.35
14B6	.87
14B8	1.75
14C5	1.50
14C7	1.75
14E6	1.25
14E7	1.25
14F7	.87
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17BS3	.86
17C5	.56
17C9	1.18
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18FX6	.51
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19BG6	1.35
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19CL8	.57
19EA8	.77
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22BW3	1.43
22DE4	.67
22JG6	1.06
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25AC5	2.00
25AK4	.66
25AV5	1.00
25AX4	.68
25BK5	.89
25BQ6	1.12
25B8	1.73
25C5	.51
25CA5	1.85
25CD6	1.50
25DK4	1.05
25DN6	1.50
25EH5	.53
25F5	.56
25L6	.55
25W4	.66
25Z5	1.10
25Z6	.73
27GB5	1.75
32ET5	.53
32L7	.85
33GY7	1.40
34DG5	.51
34GD5	.79
35A5	.85
35B5	.95
35C5	.49
35EH5	.55
35L6	.58
35W4	.40
35Y4	1.63
35Z3	1.20
35Z5	.58
50A1	3.95
50A5	1.49
50B5	.68
50C5	.51
50DC4	.46
50EH5	.95
50HC5	.86
50HK6	.54
50L6	.59
50X6	.67
50Y6	.95
50Y7	1.10
60FX5	.60
70L7	.89
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117P7	3.95
117Z3	.83
22	.95
24A	.95
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27	1.50
28D7	1.50
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33	.85
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35-51	.85
36	.95
37	.70
38	.90
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41	.95
42	1.25
43	1.20
45	2.00
46	.95
47	2.10
48	3.50
50	1.45
53	2.98
55	1.90
56	.95
57	1.35
58	1.85
59	2.50
71A	.95
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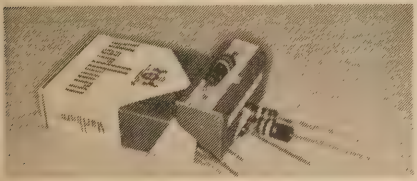
soldering lug and fasten each lug to the base with a screw and a nut. Now each lead has a binding post, and you can avoid further soldering on the transistor leads.—*Albert Koehler*

PRICE SHEET UNDER GLASS

Many times tube price lists are stuck on the wall or thrown on the counter where they are hard to find or get lost. I cleaned up a safety glass from an old 17-inch TV receiver and fastened my tube list-price sheets, picture-tube prices and antenna work prices to its back surface. Simply use masking tape to hold them in place. The tape can be removed easily when prices change. This keeps the prices clean and handy and always before you when needed. Place the glass on the counter near the cash register. It is even nice to write orders on.—*Homer L. Davidson*



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Empty flip-top cigarette boxes make ideal storage containers for resistors and capacitors. The boxes stack easily on a shelf or in a drawer.

Each box is identified by mounting one unit of its contents on the cover. Simply push the leads through two holes punched in the cover and bend them over. This also supplies a handle.
—*Royland Pettersen* END

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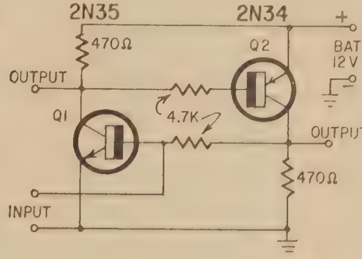
new Patents

Complementary Multivibrator

PATENT No. 3,121,802

William F. Palmer, Carlisle, Mass. (Assigned to Sylvania Electric Products, Inc., Wilmington, Del.)



In most multivibrators, the transistors conduct alternately, so power is consumed whether the device is on or off. Here they conduct simultaneously or are cut off together. Power is switched off when the multivibrator is off.

When Q1 conducts, it feeds a negative pulse to the base of Q2 which then conducts also. If Q1 is cut off, so is Q2, because of lack of forward bias.

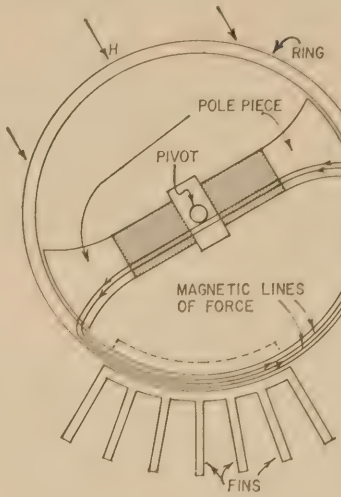
A positive signal at the input drives both transistors to conduction. A negative pulse switches them off. The two output terminals provide a choice of outputs of either polarity.

THERMOMAGNETIC DEVICE

PATENT No. 3,121,625

Siegfried R. Hoh, 240 Forest St., Belleville, N.J.

This device uses magnets controlled by heat. It may be used to close venetian blinds automatically, to point solar devices toward the sun, and to steer satellites.



A bar magnet (shaded in the figure) is pivoted to rotate within a ferrite ring. The ferrite has a permeability that falls with temperature. It also exhibits a low Curie temperature (at which permeability reaches unity). The magnet can rest in any position when the ring's temperature is uniform.

When heat falls on the ring (arrows), the area H becomes nonmagnetic. Therefore the bar magnet rotates to the position shown. Cooling fins radiate heat away from the ring. END

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18**	.20	.30	.50	.75
35	.70	1.00	1.35	1.50
100	1.65	2.05	2.50	3.15
240	3.75	4.75	5.75	8.75
D. C. Amps	**300Piv 210Rms**	**400Piv 280Rms**	**500Piv 350Rms**	**600Piv 420Rms**
3	.29	.30	.40	.48
12	1.00	1.35	1.45	1.70
18	1.10	1.50	Query	Query
35	2.15	2.45	2.75	3.30
100	3.75	4.60	5.50	8.00
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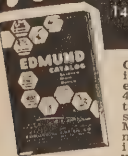

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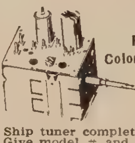

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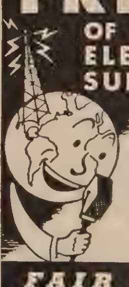

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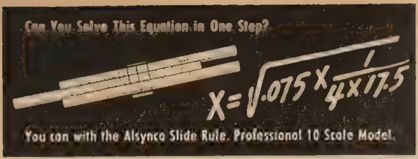
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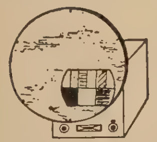

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RADIO-ELECTRONICS does not assume responsibility for any errors which may appear in the index below.

Aerovox Corp. (Distributor Div.) 24
Allied Radio Corp. 15
Amperex Electronic Corp. Second Cover
Amplifier Corp. of America 90
B & K Manufacturing Co., (Div. of Dynascan Corp.) 59
Bozak 104
Brach Manufacturing Corp. (Div. of General Bronze Corp.) 70
Brooks Radio & TV Corp. 102-103
Burstein-Applebee Co. 78
Capitol Radio Engineering Institute, The 10-13
Castle TV Tuner Service, Inc. 8
CLASSIFIED 112
Cleveland Institute of Electronics 3, 62-65
Colman Electronic Products 102
Conar (Div. of National Radio Institute) 84
Continental Radio Co. 111
Coyne School Publications 97
Datak Corp., The 72
DeVry Technical Institute 7
Edlie Electronics 105
EICO Electronics Instrument Co., Inc. 19
Electronic Measurement Corp. (EMC) 95
Finney Co. 91
Gernsback Library 92, 103
Griffiths Electronics 87
Heald's Engineering College 109
Heath Co. 71, 73, 75
I.E.E.E. 104
International Crystal Manufacturing Co. Inc. 114
Jensen Manufacturing Co. (Div. of the Muter Co.) Third Cover
Jerrold Electronics 17
JFD Electronics Corp. 20-21
Lafayette Radio Electronics 98-100
Mallory & Co., Inc., P.R. 89
Mercury Electronics Corp. 66
Milwaukee School of Engineering 107
National Radio Institute 29-30, 101
National Technical Schools 5
Olson Electronics, Inc. 88
P.A.F. Enterprises 88
Perma-Power Co. 14
P.F. Reporter 90
Philco Techrep Division (Subsidiary of Ford Motor Co.) 95
Polypaks 113
Progressive "Edu-Kits", Inc. 94
Quam-Nichols Co. 79
RCA Electronic Components and Devices
  Test Equipment 60
  Tubes Fourth Cover
RCA Institutes 80-83
RCA Parts and Accessories 68-69
RCA Sales 23
Reading Improvement Program 74
Sams & Co., Inc., Howard W. 9, 86
Sarkes Tarzian, Inc. (Tuner Service Div.) 62
Scott, Inc., H. H. 87
Sencore 93
Shure Brothers, Inc. 28
Sonotone Corp. 18
Sprague Products Co. 16
Superscope, Inc. 24-25
Sylvania (Subsidiary of General Telephone & Electronics) 67
Tall Company, The 74
Tarzian, Inc. Sarkes (Tuner Service Div.) 61
Triad Distributor Div. (Div. of Litton Industries) 22
Turner Microphone Co. 85
United Radio Co. 108
University, LTV (Div. of Ling-Temco-Vought, Inc.) 76-77
Weller Electric Co. 96
Winegard Co. 26-27
MARKET CENTER 110-111
Alsynco
Barry Electronics Corp.
Colordaptor
Denson Electronics Corp.
Edmund Scientific Corp.
Electronic Components Co.
Fair Radio Sales
Komet Electronics
Laranco Distributors
Music Associated
Oelrich Publications
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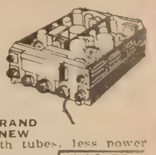

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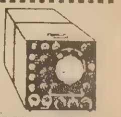

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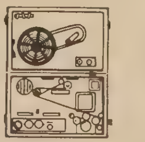

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PRACTICAL OSCILLOSCOPE HANDBOOK, Vol. 1—Introduction/Basic Tests and Measurements; Vol. 2—Industrial and Laboratory Tests and Measurements, by Rufus P. Turner. *John F. Rider Publisher, Inc., 116 W. 14 St., New York, N.Y. 10011. 5½ x 8½ in., 225 pp. Paper, $5.90*

Volume 1 explains in the clear and simple language we have come to expect from Turner what the oscilloscope is, how it works, and how to make ordinary, service-type measurements with it. Volume 2 describes more advanced uses, beginning with the features of professional oscilloscopes and going on to recording from the scope, and then discusses checks of various physical quantities, conponents and performance, at the professional level.

RADIO OPERATING QUESTIONS AND ANSWERS (13th edition), by Jules L. Hornung and Alexander A. McKenzie. *McGraw-Hill Book Co., 330 W. 42 St., New York, N.Y. 10036. 5¼ x 8 in., 598 pp. Cloth, $8.25*

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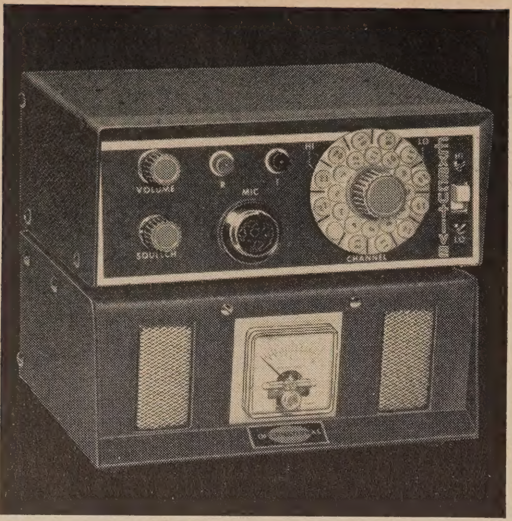

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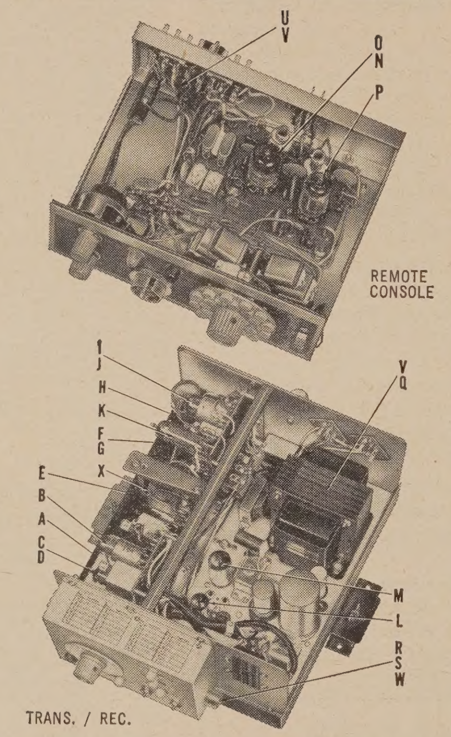

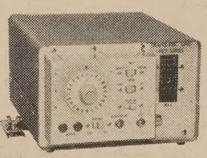

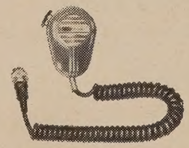

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A	RF Amplifier Cathode
B	1st Converter Screen
C	2nd Converter Screen
D	2nd Rec. Osc. Grid
E	1st IF Amp. Cathode
F	2nd IF Amp. Cathode
G	2nd IF Screen
H	Rec. "S" Meter-Trans. Audio Out
I	1st Audio Plate
J	2nd Audio Cathode
K	Audio P.A. Cathode
L	Buffer Grid
M	Rec. Relay Voltage-Trans. P.A. Bias
N	Trans. Osc. Grid
O	Trans. Adder Grid
P	Channel Osc. Grid
Q	Power Supply B+ Voltage
R	Reflected RF Power
S	RF Power Output
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U	Bat.—Volts Pos Gnd.
V	Fil. Voltage Level
W	Percentage of Mod.
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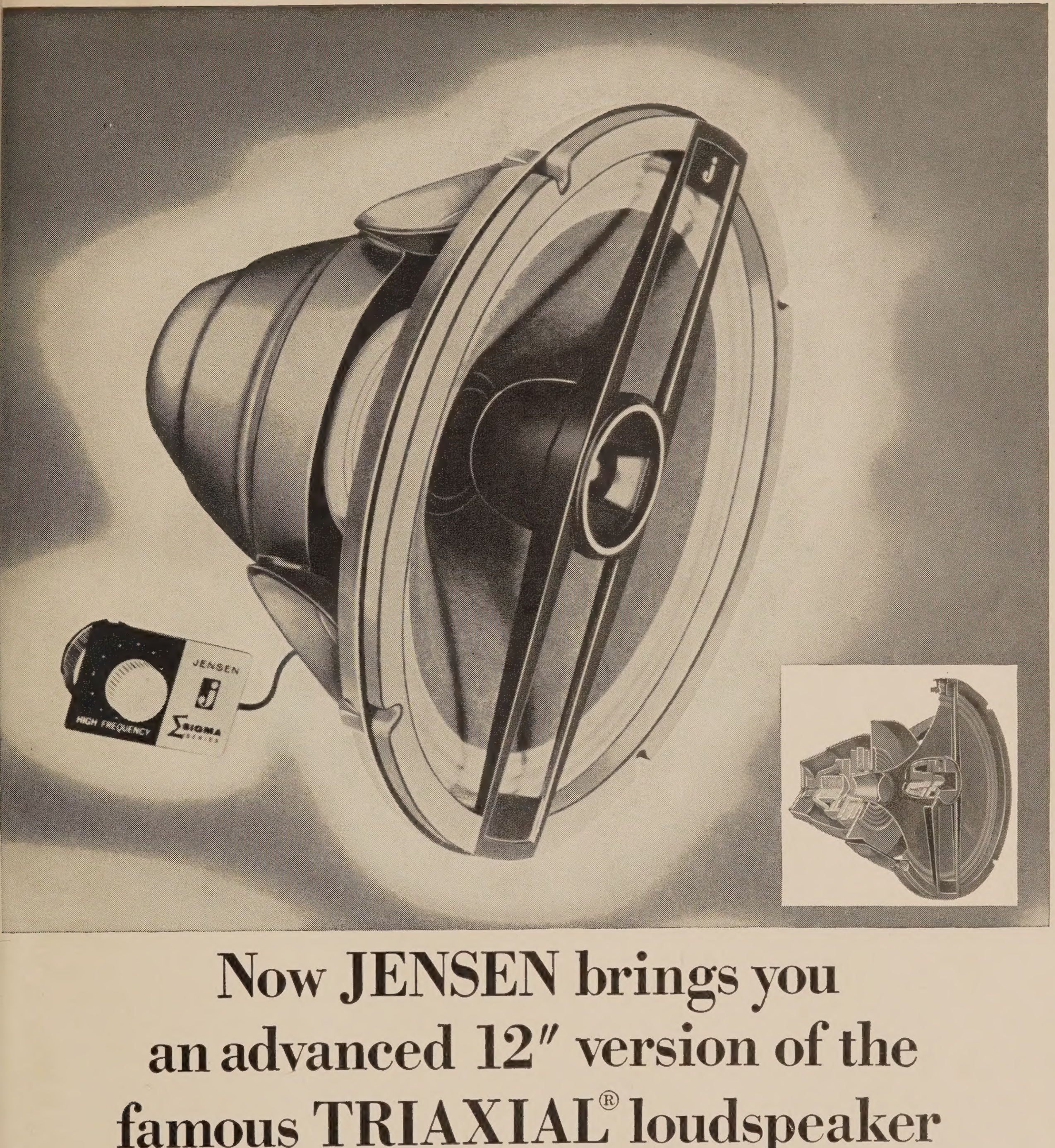

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